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(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
6 September 2002 (06.09.2002)

PCT

(10) International Publication Number  
**WO 02/069175 A1**

(51) International Patent Classification<sup>7</sup>: **G06F 15/177**,  
15/173

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(21) International Application Number: PCT/US02/06000

(22) International Filing Date: 27 February 2002 (27.02.2002)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
60/272,279 27 February 2001 (27.02.2001) US  
09/963,871 25 September 2001 (25.09.2001) US

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(81) Designated States (*national*): AE, AG, AL, AM, AT, AU,  
AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU,  
CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM,  
HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK,  
LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX,  
MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL,  
TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

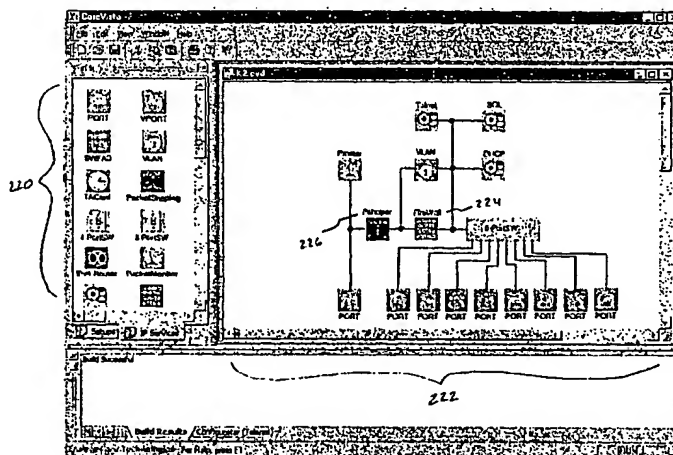
(84) Designated States (*regional*): ARIPO patent (GH, GM,  
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW),  
Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),  
European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR,  
GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent  
(BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR,  
NE, SN, TD, TG).

Published:

— with international search report

[Continued on next page]

(54) Title: MANAGEMENT TOOL AND GRAPHICAL INTERFACE FOR CONTROL OF AN OPEN INTERNET PROTOCOL SERVICES PLATFORM



(57) Abstract: A management tool having a graphical interface for controlling Open IP Services Platforms, (30) wherein the platforms provide any combination of functions of common network devices such as routers, bridges, firewalls, packet shapers, switches, load balancers, and servers in a single device, wherein the network devices are interconnected to function as a network through the management tool that enables drag-and-drop configuration of the network devices, and wherein configuration of the network is performed through changes in software and not physical rearrangement. Within the display contains an objects pane (220). The objects pane includes icons that represent network functions that are offered by the particular Open IP Services platform. Configuring the network through selecting an object from the object pane and dragging-and-dropping it to the configuration pane (222).

WO 02/069175 A1



— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

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MANAGEMENT TOOL AND GRAPHICAL INTERFACE FOR CONTROL OF  
AN OPEN INTERNET PROTOCOL SERVICES PLATFORM

BACKGROUND

5     The Field Of The Invention: This invention relates  
generally to the management of open Internet Protocol  
(IP) tools and services. Specifically, the present  
invention is management software having a graphical  
interface that facilitates management of a new type of  
10   Open IP Services Platform that provides network  
services that are typically performed by discrete  
components.

15   Background of the Invention: Access to the Internet or  
other global information networks is generally  
becoming a commodity as Service Providers (SPs) and  
Local Exchange Carriers (LECs) look to new value-added  
applications and services in order to retain  
customers, attract new business clients, and generate  
20   revenue. Enterprises face a limited supply of  
certified network administrators, increased demand for  
high-bandwidth network services, and the need to  
reduce the total cost of ownership while preserving  
existing infrastructure investments.

25         Unfortunately, existing solutions for SPs and  
LECs fall short in a number of important areas. For  
example, most customer-premise equipment (CPE) is not  
Telco quality, thus resulting in inconsistent,  
unreliable service and problematic service agreements.  
30   Next, integration between network devices from a  
variety of vendors is difficult at best. Furthermore,  
a lack of extensibility and flexibility makes CPE  
difficult to scale. New application services can  
require a large upgrade, or at least a visit to the

customer to modify or replace equipment. There are almost always new costs associated with every new piece of Internet Protocol (IP) functionality, as well as additional management issues. Finally, each piece of equipment requires a separate management interface, preventing network-wide visibility.

The issues above all combine to prevent delivery of revenue-generating, differentiated IP services to an increasingly demanding customer base.

Current network designs typically require a discrete piece of equipment for each network function to be performed. For example, an Enterprise will typically include network devices that interface with desktop computers and servers, and connect them to the Internet or other network. The network devices includes servers, switches, routers, bridges, firewalls, load balancers, packet shapers, etc. Managing this wide conglomeration of network devices requires a significant amount of time and vendor-specific expertise.

As network requirements expand and change, the need for specialized network services also changes. For example, repositioning a single network device within a network architecture disadvantageously necessitates both network downtime and a physical presence to make the changes. It is useful to examine a typical network configuration for an Enterprise to better understand the problem.

Figure 1 is an illustration of a typical network topology 10 of the prior art. The interface between desktops 12 and servers 14 to a network, such as the Internet 16, typically includes network devices or components such as a router 18, a firewall 20, a

packet shaper 22, and at least one switch, but where two switches 24, 26 are shown in this figure. Another server 28 might also be part of this interface, when the server is providing network services such as in an SQL server, DNS server, Web server, etc.

Each of the discrete components listed above is disposed within its own "box." Each box occupies a certain amount of space, or footprint. Each box must also have its own power supply. Finally, each box will have a unique interface that typically requires substantial knowledge of the device in order to operate.

It would be an advantage over the state of the art to provide network administrators with a management tool that enables graphical control over all of the components that are installed within the Open IP Services Platform in order to provide a consolidated, flexible, scalable, and less complex management solution that can be customized according to a customer's needs. Such management software and graphical interface should enable network components, both the hardware and the software, to be included from any vendor. It would also be an advantage to decrease the level of complexity of the solution such that management software can be operated by a person with limited computer network and vendor-specific knowledge.

In order to assist the network administrator, it would also be an advantage to provide a plurality of pre-configured or "canned" or pre-configured graphical network configurations. Thus, for relatively simple network configurations, the administrator would not even have to design the network topology, as long as

the available network components matched the pre-configured network configuration.

It would also be an advantage over the prior art to provide a solution where the network configuration can be modified on the fly using the new management tool and graphical interface. The management tool should also be capable of enabling control of the system, if desired, down to single network port control, or sophisticated enough to manage all of the network ports as determined by network conditions.

It would also be an advantage to provide a plurality of these systems such that they can be coupled together in a large network, be it the Internet, or a more localized WAN or LAN topology. The system should also enable spare processing capability to be made available for other applications, without degradation of the network functions being performed.

It would also be an advantage to provide third parties with the ability to have greater control of how their plug-in hardware or software operates with the invention by enabling programming of ActiveX modules that enable components to be dragged and dropped in the new management tool and graphical interface.

**Summary of Invention:** It is an object of the present invention to provide a system that utilizes a new management tool having a graphical interface for organizing and controlling Open IP Services Platforms disposed in a network.

It is another object to provide the system wherein the management tool provides the ability to

drag and drop icons representing network components into any desired configuration, wherein the network components include a router, bridge, load balancer, firewall, packet shaper, switch, server, or any other network devices.

It is another object to provide the system wherein the interconnections between the network components are modified through the management tool.

It is another object to provide the system wherein the interconnections made by the management tool between network components can be modified without taking the network down to make the changes.

The present invention is embodied in a system comprising a management tool having a graphical interface for controlling Open IP Services Platforms, wherein the platforms provide any combination of functions of common network devices such as routers, bridges, firewalls, packet shapers, switches, load balancers, and servers in a single device, wherein the network devices are interconnected to function as a network through the management tool that enables drag-and-drop configuration of the network devices, and wherein configuration of the network is performed through changes in software and not physical rearrangement.

These and other objects, features, advantages and alternative aspects of the present invention will become apparent to those skilled in the art from a consideration of the following detailed description taken in combination with the accompanying drawings.

#### Description of the drawings:

Figure 1 is a block diagram of a typical network



topology of the prior art.

Figure 2 is a block diagram that is made in accordance with the principles of the presently preferred embodiment.

5           Figure 3 is a block diagram that explains how the Open IP Services Platform 30 incorporates a Level 4 switch router at the bottom level, and a general purpose central processing unit (CPU) 34 at the top level.

10           Figure 4 is a block diagram that is provided to give greater detail to the configuration of the Open IP Services Platform.

Figure 5 is an example of the COREVISTA WEB(TM) main page.

15           Figure 6 is an example of the Open IP Services Platform's hardware ports.

Figure 7 is an example of the selected ports configuration page.

20           Figure 8 an example of users and the application module which each user can access.

Figure 9 is an example of the configuration management page.

Figure 10 is an example of a port-based statistics page.

25           Figure 11 is an example of a port-based statistics graph.

Figure 12 is an example of a protocol statistics page.

30           Figure 13 is an example of a protocol statistics graph.

Figure 14 is an example of an APACHE(TM) management page.

Figure 15 is an example of a Virtual Hosts Page.

Figure 16 is an example of a Bandwidth Management page.

Figure 17 is an example of a DHCP network parameters page.

5 Figure 18 is an example of a DNS management page.

Figure 19 is an example of a Firewall Management page.

Figure 20 is an example of a Network Address Translation (NAT) Interface page.

10 Figure 21 is an example of the Network Management Page.

Figure 22 is an example of the Interface Management page.

15 Figure 23 is an example of the Port Forwarding page.

Figure 24 is an example of the qmail Management Page.

Figure 25 is an example of the Routing Configuration page.

20 Figure 26 is an example of the SANGOMA(TM) Interface page.

Figure 27 is an example of the VLAN Management page.

25 Figure 28 is an example of the VPN Client Configuration page.

Figure 29 is an example of the FTP page.

Figure 30 is an example of the SSH page.

Figure 31 is an example of the SWAT page.

Figure 32 is an example of the WEBMIN(TM) page.

30 Figure 33 is an example of a COREVISTA(TM) configuration page.

**Detailed Description:** Reference will now be made to

the drawings in which the various elements of the present invention will be given numerical designations and in which the invention will be discussed so as to enable one skilled in the art to make and use the invention. It is to be understood that the following description is only exemplary of the principles of the present invention, and should not be viewed as narrowing the claims which follow.

The present invention is a unique software management tool that enables a network administrator to design, configure, and control a network utilizing drag-and-drop icons that represent the network components that are provided in Open IP Services Platforms. The management tool is provided by EmergeCore Networks, and will be referred to hereinafter as COREVISTA WEB(TM).

COREVISTA WEB(TM) is an important element of an overall system that includes the Open IP Services Platforms as described in the patent application cited at the beginning of this document. COREVISTA WEB(TM) is the software tool that manages the Open IP Services Platforms. The Open IP Services Platforms are capable of functions that are found in no other device. To understand the benefits of COREVISTA WEB(TM), it is useful to discuss some of the advantages of this Open IP Services Platform.

Typical network components include but are not limited to routers, bridges, firewalls, packet shapers, switches, load balancers, and servers. These devices can all be found on a first side of the router, wherein on the second side, the router functions as a gateway to networks such as LAN segments, WANs, and the Internet or other global

information networks. The specific topology of these networks on the first side of the router can vary significantly depending upon the needs and functions of the local network segment. Thus, several of the problems that the present invention overcomes include

- 1) the total number of physical devices that may be required for a network,
- 2) the number of wires that must be installed between the devices,
- 3) the time required to configure the devices,
- 4) the level of knowledge of the person that is installing the devices,
- 5) an understanding and memory of the specific topology that has been set up, and
- 6) the ability to reconfigure a network topology on-the-fly.

The presently preferred embodiment of the invention is able to overcome these problems for several reasons. First, all of the network devices can be physically disposed within a single unit, or Open IP Services Platform. Obviously, there are many obstacles that must be overcome to do this. For example, the Open IP Services Platform of the present invention is constructed to accept network components from third parties. In other words, it is not a feature of the present invention to provide these network components, rather it is an aspect of the invention to provide a device that can house them in the Open IP Services Platform. Not only can these network components be disposed within the Open IP Services Platform, but more than one type of network component can be housed together. Essentially, all of the network components listed previously can be housed within a single unit of the Open IP Services Platform.

In order to dispose these network components together so that they function, several novel elements

of the present invention had to be developed. A first aspect was a system for configuring the interconnections between the network components in the Open IP Services Platform. Consider multiple switches and a packet shaper disposed within the Open IP Services Platform. The packet shaper must be coupled to specific ports of the multiple switches. It is a novel aspect of the invention to provide the software management tool COREVISTA WEB(TM) that provides configuration control by physically interconnecting network devices that are stored within the Open IP Services Platform. Control is provided at what can be considered to be two levels. The first level of control enables the user to make specific port assignments if the system administrator is experienced, while the second level of control takes specific port assignments out of the hands of the administrator, and allows the specific configuration of ports to be left to the configuration software (COREVISTA WEB(TM)) if the system administrator has only a limited understanding of network topology, or does not desire to control the network at such a detailed level.

It should be mentioned that COREVISTA WEB(TM) is simple enough to operate that a network specialist does not have to be brought in to set up the Open IP Services Platform. This aspect of the invention is made possible because the interface provides drag-and-drop configuration, as well as pre-configured network topologies or "loads."

With this brief introduction, an example of an Open IP Services Platform is shown in figure 2. Figure 2 illustrates that all of the network services

provided by individual network components 18, 20, 22, 24, 26, 28 have been replaced by a single Open IP Services Platform 30. It should be remembered that any or all of the functions of the network devices described above can be replaced as desired.

Figure 3 is a block diagram of the presently preferred embodiment of the present invention. This figure is provided to illustrate that the Open IP Services Platform 30 incorporates a Level 4 switch router 32 at the bottom level, and a general purpose central processing unit (CPU) 34 at the top level. It should be mentioned that while a general purpose CPU is preferred, any type of specialty CPU can be substituted. The reason for preferring a general purpose CPU is that it is going to be more flexible. In other words, the Open IP Services Platform 30 can do more than just function as a unit for consolidating network functions if it is given more processing power and ability to run more programs. The drawback is that a specialty CPU can be faster. However, given the fact that general purpose CPUs have increased in operation capabilities so rapidly, it is unlikely that the CPU would be a bottleneck to performance for most situations where the Open IP Services Platform is deployed.

The switch router 32 communicates with the CPU 34 via an internal Peripheral Component Interconnect (PCI) bus 36. Presently, that translates into a communication conduit of 240 Mbps between those components 34, 36. However, the switch router 32 is communicating at wire speed with network components in levels 2-4.

It is noted that it would take an OC-3 connection

to the Internet for the input to the Open IP Services Platform 30 to exceed the processing throughput capabilities of the CPU used in the preferred embodiment. The OC-3 type of connection is uncommon  
5 to most businesses, and thus the present invention is going to handle almost all connection scenarios without becoming a bottleneck. It is envisioned, however, that this bottleneck will also be overcome.

Figure 4 is a block diagram that is provided to  
10 give greater detail to the configuration of the Open IP Services Platform 30. The CPU 34 is preferably a single board computer (SBC) operating with an INTEL(TM) chipset. The preferred microprocessor for the SBC 34 is an INTEL(TM) PENTIUM(TM) III. The SBC  
15 34 communicates with memory in the form of SDRAM DIMMs 38, and possibly an array of hard drives/flash drives 40. The hard drives/flash drives 40 are optional, depending upon the needs of the network or of the network components being incorporated into the Open IP  
20 Services Platform 30, as will be explained.

The switch router 32 is shown coupled to the SBC 34 via the PCI bus 36. The switch router 32 has also been labeled as a network accelerator to more fully describe its function. The switch router 32 is shown  
25 as providing the port connections to external networks via the Gigabit Ethernet Fiber (GBIC) Ports 42, 10/100 Mbps Ethernet (Base T) Ports 44, PCMCIA Expansion Ports 46, and additional PCI Expansion Slots 48.

The PCI Expansion Slots 48 are designed to  
30 receive the hardware of the network function being installed. In other words, a third party network function card is installed in one of the PCI Expansion Slots 48, enabling the Open IP Services Platform 30 to

function as a load balancer, a firewall, etc.

It is also noted that optional cards 50 can also be installed into the PCI Expansion Slots 48. These optional cards can include such functions as OC-3, DSL  
5 modem, T1/E1 termination, and SCSI RAID. Thus it is seen that the Open IP Services Platform 30 is not fixed in its configuration or its function.

Another advantage of utilizing an open architecture OS is that some users will want to drop  
10 their own software into the Open IP Services Platform 30. Unfortunately, this flexibility also enables users to write code that can potentially interfere with the other functions in the Open IP Services Platform 30. Advantageously, the complete OS provides  
15 memory management that prevents third party software from jeopardizing the operation of any other network functions taking place.

The Open IP Services Platform 30 is also operated by a multi-tasking operation system. In the presently  
20 preferred embodiment, a stable and secure OS is desired. The Open IP Services Platform 30 is currently operated using FreeBSD or Linux. It is also important to understand that the OS operation within the Open IP Services Platform 30 is not what is  
25 typically referred to as an embedded OS. An embedded OS is often a smaller and less capable version of the complete OS. The present invention utilizes the complete OS so that all capabilities of the OS are available. These capabilities include the all-  
30 important security features.

The Operating System 52 executes third party applications 54, with the global rules 56 including management, statistics, and Quality of Service flow



rules, and network services rules 58. Network service rules 58 include restrictive flow control, security, a DNS server, file services, bandwidth metering, a DHCP server, a firewall, and external service packs.

5           The Operating System 52 communicates with the interface 60 of the SBC 34. This communication is controlled via policy interface 62. Virtual interconnects 64 handle the translation within the SBC 34 of mapping virtual NIC instantiations 66 to  
10           physical port instantiations 66.

          Presently, COREVISTA WEB(TM) is utilized to control two different Open IP Services Platform configurations, the REACTOR 3000(TM) and the REACTOR 5000(TM). There are several common features in these  
15           products including: two Gigabit GBIC Ports 42, twenty four 10/100 (Base T) Ports 44, a single 733 MHZ PENTIUM(TM) III CPU 34 that is ungradable, 32 MB of RAM and 32 MB of Flash RAM 38, both ungradable, two  
20           USB ports, one serial port that is optional, and two PC card slots 46, type 2. The devices are different in that there are two PCI bus slots, and an optional hard drive on the REACTOR 3000(TM). In contrast, the REACTOR 5000(TM) includes four PCI bus slots, and comes with two RAID bays for up to 6 hard drives, and  
25           a redundant power supply. Both systems are configurable via local PC, serial port, modem, or via a network connection. More control is possible, however, using a configuration program that operates in the WINDOWS(TM) environment.

30           It is observed that presently both systems run FreeBSD 4.2 and Linux Kernel 2.2.17 (RedHat 6.2 or 7.0, Mandrake 6.2) Operating Systems. However, a PC running any Operating System can communicate with them

via Telnet or a command line interface. But the software configuration tool, COREVISTA WEB(TM), is currently a WINDOWS(TM) application.

5 When considering how the present invention is different from the state of the art, the present invention hooks the networking functions into a server to make network functions more seamless. In other words, instead of just operating as a Network Interface Card (NIC) tied into a switch or router, the  
10 present invention provides full control over the switch and router functions. This approach is different from the state of the art because no one has previously tried to provide this type of interface that enables a third party to load their own  
15 components into a box providing some type of network function. In fact, this approach is antithetical to the business model of any other network function provider. For it is the desire of suppliers of network functions that the user not try to add  
20 hardware or software components of a third party into their own box. Obviously, this type of approach severely limits trying to build a "best of class" network if a user can only install certain brands of products when interoperability is a must.

25 Thus, the present invention performs the unique function of being an integrator of network products that have previously required separate boxes or isolated operation in order to function. Advantageously, the present invention does not have to  
30 try and provide any of the network functions themselves, but instead provides a box that enables network cards performing all manner of functions to be disposed therein, while providing the hardware and

software to make interconnections between the different network cards. Thus, even though the present invention does provide switch/router capabilities, even these functions can be replaced or enhanced by the addition of a third party switch or router card.

Another way to look at the invention is seen by examining its use of virtual NICs. Using virtual NICs, in the sense that they present a standard interface like a normal driver, up to the services and stacks above it in the software, the software believes it is communicating with a normal driver when it is not. A novel aspect of the invention is to be able to dynamically remap it to other services within the Open IP Services Platform. This means the data does not have to be serialized/deserialized. This also gives the present invention the ability to remap to physical ports down through the bottom end of a networking stack. Another advantage is the ability to create rules based on a specific interface. Thus, the use of virtual NICs provides the invention with the ability to map processes to processes.

Another use of the virtual NICs has to do with memory allocation. Typically, a pool of memory resides with the driver. Memory is handed off to other resources as needed. Memory, in this case a buffer, is eventually released and given back to a driver. An important aspect of the invention is to share all of the buffers across all of the virtual NICs.

For example, consider a packet of data received by a router installed in the Open IP Services Platform. The router would have had down a tag or pointer

for data stored in a buffer to a virtual NIC interface, which would hand the tag to a firewall. Thus, the data in a buffer is no longer being transferred or copied from buffer to buffer as each  
5 new process receives the data in the buffer, but instead the data remains in the same buffer, and control of the tag to the buffer is what is passed from process to process. Thus, the Open IP Services Platform becomes very fast and very efficient in its  
10 handling of packets because the present invention utilizes the virtual NICs or virtual interconnect that handles buffer data management across the services, rather than individually. Thus, buffer management is done globally, but handled at a low level. Thus, the  
15 allocation of memory in the buffer pool is known at all times because buffer management is being handled globally.

Another aspect of the invention to consider is the combining of a server and switch. By doing so,  
20 the server has full access to all the data because the server has all of the protocols. Thus, the switch becomes a full router, with the ability to process and manipulate the data. Consider the advantage of being able to serve data immediately to a port so that the  
25 network itself does not become a bottleneck. For example, a typical network infrastructure limits speed of data to the 100 Mbit or 1 Gbit data pipes. But by merging the server and the switch together, data now moves at the speed of the bus in the server, which can  
30 be much greater. Furthermore, providing multiple system buses within the server provides the function of scalability by using the Open IP Services Platform  
30.

One of the novel aspects of the invention is that because the present invention is not trying to duplicate the functions of a proprietary firewall, call it Firewall A, there are no licensing fees to be paid because Firewall A is purchased and put into the Open IP Services Platform 30. The Open IP Services Platform 30 thus provides all of the functionality of Firewall A because it is the actual Firewall A. Likewise, Load Balancer B is manufactured by a different company, is purchased, and disposed within the Open IP Services Platform 30 next to Firewall A. Firewall A and Load Balancer B now provide all of their functionality in a single box. All interconnections between them are provide by the present invention down to a port-by-port basis.

Another novel aspect of the invention is that it prevents exclusivity of function. Suppose that the manufacturer of Firewall A enters into an exclusive contract such that it is no longer available for use in the Open IP Services Platform 30. Advantageously, Firewall A is removed and Firewall B is put in its slot. After loading Firewall B's drivers, it is likely that no other configuration of Firewall B will be required. The firewall functions will operate as before.

It is another aspect of the invention that most network functions can be added into the Open IP Services Platform 30 without modification. The only requirement is that the driver for the network function be provided for the OS that is running on the Open IP Services Platform 30.

Another aspect of the invention is that the Open IP Services Platform 30 can communicate at wire speed

with other Open IP Services Platforms. This is advantageous when, for example, a particular function is not being performed fast enough in one particular unit. Just one function can be rerouted at wire speed to another Open IP Services Platform 30.

Consider an Open IP Services Platform 30 that is performing the functions of a server that is providing FTP, web services, mail services, etc. It is possible to assign any of the services to different servers (Open IP Services Platforms 30), at wire speed, to keep performance at a desired level. The present invention can also reconfigure the Open IP Services Platform 30 on the fly such that when certain performance bottlenecks are being reached, the Open IP Services Platform 30 will reassign functions as previously defined by the administrator.

Another feature of the present invention is that both configurations of the Open IP Services Platform 30 provide keyboard, mouse, and monitor ports. Thus, the Open IP Services Platform 30 is a full-fledged server that a developer can work on directly.

Another novel aspect of the invention that increases versatility is the type of environments in which the Open IP Services Platform 30 can operate. Small businesses are often stashing network components into closets or other tight spaces. This closed environment typically runs hotter than a room with its own thermostat. Accordingly, the Open IP Services Platform 30 would normally run at a higher than optimal temperature. Another aspect of the invention is to provide a solid state refrigeration unit. This aspect is especially important when considering the commercial and industrial locations where the Open IP

Services Platform 30 will be used. This is also more important for the REACTOR 5000(TM) model that includes hard drives. Hard drives are especially vulnerable to high operating temperatures. The refrigeration unit  
5 can be disposed just on the hard drives themselves.

With these features in mind, it is useful to consider the manner in which the present invention utilizes them to achieve novel advantages, while observing that the advantages are available to all of  
10 the targeted core markets of SPs, LECs and Enterprises. First, the invention provides a consolidated equipment solution. Managing a wide array of single-function, multi-vendor network devices creates high installation and management costs. The  
15 present invention consolidates the many functions performed by the individual network devices. The equipment consolidation can be partial or total, with a single device replacing entire racks of physical equipment. Consolidation of network functions solves  
20 a critical long-term build-out problem in Enterprise IT rooms, SP data centers, and in LEC central offices where equipment proliferation often overwhelms available power, air conditioning or physical space limitations. Consolidated equipment means that there  
25 are fewer interconnections, fewer cables, and fewer moving parts to fail, resulting in increased uptime and reduced ongoing support costs.

Consolidated network equipment greatly simplifies installation and ongoing maintenance. The present  
30 invention includes an elegant, intuitive, centralized management tool, COREVISTA WEB(TM), that enables installation in a very short time relative to installation of multiple discrete network components.

Thus, the administrator can deploy units without needing to complete multiple, vendor-specific, certified training programs as will be explained. The present invention even offers self-configuring features on base units.

The flexible allocation of network resources is made possible because COREVISTA WEB(TM) is used to make all connections between network devices installed in the present invention. Any single or combination of virtual or physical ports can be instantly reassigned new IP services on a port-by-port basis. This enables the administrator to reconfigure IP services as needs change, and without taking down any part of the network. This aspect is especially critical to large Enterprises, and almost any SP and LEC.

One of the greatest advantages of the present invention is the use of open IP standards. Proprietary technologies are often initially attractive because lower costs can be achieved for a specific function. Disadvantageously, however, proprietary technologies often limit selection of complementary equipment, leaving the network function isolated and unexpandable. Additionally, proprietary equipment can preclude the use of certain IP services completely, and can require an administrator to provide specialized training for staff. Thus, hidden costs add up and quickly surpass any initial savings.

The present invention delivers a truly open architecture communications platform specifically designed to enable rapid deployment of "best in class" applications and value-added services for mission-critical communications, while preserving existing



infrastructure. The present invention also enables the administrator to offer any IP service through the Enterprise, SP or LEC.

5 Configuring the Open IP Services Platform 30 can be performed in various ways. To drag and drop icons representing the network components requires that the administrator access the Open IP Services Platform using the COREVISTA WEB(TM) configuration and control program. In contrast, access over the web using  
10 COREVISTA WEB(TM) enables the administrator to configure what is already loaded in the Open IP Services Platform 30, but not to design the layout. In other words, it enables the administrator to configure what is already loaded, but not change the  
15 layout.

When performing configuration over a network, it is noted that SSH is provided for a secure and encrypted configuration session.

One useful feature is that the configuration can  
20 be stored on and loaded from a PC card. Thus, if an SP or LEC needs twenty identical Open IP Services Platforms 30, only one has to be manually configured using the COREVISTA WEB(TM) configuration program. The configuration is then stored on a PC card that can  
25 be duplicated. The administrator then only has to insert the PC card into a non-configured Open IP Services Platform 30, and load the configuration using COREVISTA WEB(TM).

Both the REACTOR 3000(TM) and the REACTOR  
30 5000(TM) Open IP Services Platforms include a host of standard software applications right out of the box. These software applications include an APACHE(TM) web server, SQL(TM)-based database management, various

drivers and interface for the ports and other hardware, DHCP, IPB4 router, network access translation (NAT), a restrictive flow packet shaper, SNMP, point to point protocol (PPP), a virtual private network (VPN), a virtual LAN (VLAN), and SSH tunneling. Some Open IP Services Platforms can also include a SAMBA server, DNS, a POP mail server, and full software or hardware RAID functionality.

The present invention also provides a standardized interface to all of the network cards that can be loaded. This interface is SQL-based to enable full control over access to the network functions. It is also a function of the invention to provide ActiveX modules for each network function that is being added. The power of this feature is that, for example, the ActiveX module can be input to a spreadsheet. As the network is operating, the spreadsheet is displaying all of the statistics of that network function in realtime. The ActiveX modules are displayed as icons that can be dragged and dropped in COREVISTA WEB(TM).

One of the advantages of the present invention that may not yet be apparent is that it includes a central point of configuration control. Each network card has an associated database and ActiveX component. Thus, two firewalls can be configured in exactly the same way. Obviously, each firewall card requires its own unique driver and instruction set because they are probably proprietary systems. Surprisingly, both of the firewall cards can be controlled using the identical ActiveX component and the same database. The present invention is able to provide a centralized, standard interface program that performs

the translation between the database and the firewall cards themselves.

It was stated previously that the present invention provides allocation of network resources at the port, protocol, and IP address level. In other words, it is possible to control and thus sell IP services on a port-by-port basis. It is useful to examine several examples of how this works.

Consider an office building with four tenants, A, B, C and D. In a packet shaper that comes with the REACTOR 3000(TM), each of the tenants can be allocated Internet access by a rule set, trigger point, or manually. Rule sets are used to allocate resources. For example, the tenants can share a T1 line equally, where each tenant is restricted to 300 kb of bandwidth. A trigger point is used to activate particular rule sets, depending upon the conditions. Finally, it is possible to manually override the rule sets and trigger points.

A first example is when none of the tenants are restricted to the amount of bandwidth that they can use. Therefore, tenant A may use 800 kb of bandwidth without interfering with the other tenants. Then, tenants B, C, and D all need 200 kb of bandwidth. At this point, the bandwidth of the T1 is exceeded. A trigger point can be set so that when bandwidth demand exceeds the maximum available bandwidth, the tenants are restricted. The rule set that is activated can divide all the bandwidth equally, or still favor the heaviest bandwidth user while reducing the bandwidth to that user.

Bandwidth can also be allocated according to the type of activity that is being performed. Thus,

activity can be restricted based on protocol, or the type of activity that is occurring. Thus, all tenants can be given unrestricted flow control on e-mail, but restricted flow on web browsing or FTP.

5           It was mentioned that flow control can be managed down to a single port. For example, there can be three ports, each port having a unique firewall and flow control configuration. This configuration is created using COREVISTA WEB(TM).

10           Another feature of the present invention when rules and trigger points are useful is when access is suddenly restricted to the Open IP Services Platform 30 itself. For example, a network cable in the ground is cut by some construction activity. The Open IP  
15   Services Platform 30 can reconfigure itself based on the total available bandwidth that it sees. Thus, when a T1 line is cut, and the dial-up access becomes the only way to get out on the Internet, an Intranet, or other network, all users may be severely  
20   restricted, and yet enable vital services such as email to continue to operate, albeit slowly. However, access to web servers behind the Open IP Services Platform 30 from the outside may have to be eliminated to ensure email access.

25           Not only can access to outside networks be dynamically allocated through COREVISTA WEB(TM), but it is also possible to perform access metering. Thus, if a tenant desires to be charged only for actual use of access to an outside network, this can be done.

30           It is important to realize that the scenarios described above are available only because all of the network functions are disposed within a single box that can reconfigure itself on the fly after being

configured through COREVISTA WEB(TM).

COREVISTA WEB(TM) requires a common SQL database structure be provided that enables each network function to be controlled thereby within the Open IP Services Platform. Regarding the configuration software, it is only necessary that each network function be controlled by an ActiveX module that is linked to an SQL database. Thus, a consistent interface to the actual network cards is provided. Furthermore, third parties can develop and deliver their own ActiveX module for their network component.

By assigning each ActiveX module to its own SQL database, each network component is able to have its own password to its functionality. Therefore, an administrator can have a unique password for each network component, thereby enabling access to specific modules without compromising the entire network configuration.

The other advantage of SQL databases is that each module can be controlled by a set of rules defined in COREVISTA WEB(TM). These rules can be manually triggered, or automatically triggered by an event. The events can be time-based or triggered by network conditions. Likewise, bandwidth usage can be restricted when the demands outstrip the available supply. These events can even trigger a call for help to a system administrator or to another designated party.

This flexibility in control of the aspects of the Open IP Services Platform enable unprecedented opportunities. For example, a business can provide Internet access to any other business in a building, thus operating as a mini-Internet Service Provider

(ISP). Bandwidth can be doled out in any desired increments to users. The bandwidth can even be controlled down to the port on a switch.

5 The advantages of the management tool are made more apparent by a closer examination of its functions. But it is also important to make a distinction between two versions of the management tool. The two versions are COREVISTA WEB(TM) and COREVISTA(TM). COREVISTA WEB(TM) is the management  
10 tool that is accessed either by a direct connection, or over a network connection. Thus, a network administrator can modify the settings of an Open IP Services Platform from a remote location. In contrast, COREVISTA(TM) is the version of the  
15 management tool that can only be accessed locally or directly.

The difference in access to COREVISTA WEB(TM) and COREVISTA(TM) is related to the functions that can be performed. While both versions are capable of  
20 managing an Open IP Services Platform, COREVISTA WEB(TM) is the only version capable of remote access, and COREVISTA(TM) is the only version that is currently capable of drag-and-drop configuration. This COREVISTA(TM) is a WINDOWS(TM) application, and  
25 COREVISTA WEB(TM) is a browser-based application.

This document first describes the functionality and use of COREVISTA WEB(TM), and then describes the drag-and-drop interface of COREVISTA(TM). The first  
30 time that a network administrator uses COREVISTA WEB(TM) is when an Open IP Services Platform is being set up before connecting it to a network. In this case, the network administrator utilizes the default IP address for the URL in the browser's URL window.

Subsequent use of COREVISTA WEB(TM) to access the Open IP Services Platform allow access via the IP address that the network administrator provides the Open IP Services Platform during setup. Note that COREVISTA WEB(TM) is configured to run on port 8000 for http, and on port 8001 for https. An example of the URL to put in the URL window of a browser is https://<EC\_Reactor\_IP\_Address>:8001 for an SSL connection, or http://<EC\_Reactor\_IP\_Address>:8000 for a regular http connection.

The network administrator must enter a network password to gain access. The default username is root, and the default password is EmergeSQL. For a first time user, the network administrator is directed to a Quick Configuration page to teach how to configure basic network settings.

If this is not the first time starting COREVISTA WEB(TM), then the COREVISTA WEB(TM) main page is opened as shown in figure 5. The user is logged in with Administrator rights, enabling the user to add and modify other users and their rights, as well as manage all configurations and available databases.

COREVISTA WEB(TM) is a management tool that includes an interface with familiar components and windows. Figure 5 is a view of a browser page 200, having a tool pane 202 that enables the user to select which module to configure and manage, a content pane 204 that enables the user to view or modify a module's entries, and a status bar 206 that provides basic status information for the Open IP Services Platform.

The tool pane 202 is located along the left side of the browser page 200, and shows two groups of menus. The first group corresponds to global

configuration and administration tasks, such as Quick Configuration, Ports Configuration, and Administration of Modules, Configurations, and Users. The second group is a set of menus dynamically comprised of application modules that are available for the specific Open IP Services Platform that is being configured. These dynamic menus appear in accordance with the installed functions in the Open IP Services Platform. The bottom of the tool pane 202 has a drop-down window 208 that displays the pre-canned configurations that are available on the Open IP Services Platform. The window 208 also designates the currently active configuration. The configuration that is selected determines the modules that are listed in the expandable module menu group (second group). The active configuration is displayed at startup by default. Changing the configuration only requires selecting it from the drop down menu window 208 once the configurations are installed.

The content pane 204 is located in the main window of the browser page 200. It displays content based on the selection made in the tool pane 202. It provides the name of the configuration that is currently active. It also contains module sub-menu buttons across the top of the content pane 204 for module management.

The status bar 206 is located along the bottom edge of the browser page 200. It contains the name of the Open IP Services Platform, status, uptime, and load information.

A first time user of COREVISTA WEB(TM) is required to set up the Open IP Services Platform through Quick Configuration. Quick Configuration



enables network and Internet connectivity quickly and easily. The administrator must 1) specify basic network configuration settings for the network, 2) configure basic DNS settings for the network, 3) 5 configure basic DHCP configuration settings for the network, 4) configure basic Network Address Translation (NAT) settings for the network, and 5) specify a domain from which mail will be received. After the Open IP Services Platform is configured, any 10 of these settings can be changed by accessing the corresponding application module.

After setup, COREVISTA WEB(TM) enables the administrator to easily configure each of the Open IP Services Platform's hardware ports. The interface is 15 graphical as shown in figure 6. The administrator selects the ports to configure by clicking on the appropriate port boxes on the port display 210, and clicking on Select 212.

Figure 7 shows an example of the selected ports 20 configuration page. Note that each of the settings is changed using a drop-down box. The administrator can set speed, duplex, flow control, broadcast/multicast, back pressure, and enable/disable.

As an administrator, it is possible to manage 25 users, and determine and specify the modules and configurations that users have access to. Adding a user is performed through the Administration application as shown in figure 8. Figure 8 shows an example of users and the application module which each 30 user can access. The Administration application enables the administrator to add users, modify users, add or remove module access for each user, and add or remove services for each user.

Figure 9 is an example of the configuration management page. This page enables the administrator to manage pre-configured configurations. This includes the functions of viewing, creating, editing, copying, adding or removing modules or services, making a specific pre-canned configuration the active configuration, loading a pre-canned configuration from a PC card, and saving a pre-canned configuration to a PC card.

COREVISTA WEB(TM) also enables the administrator to manage application modules, including creating, editing, adding a service, editing a service, and enabling or disabling a specific application module in a configuration.

Another advantage of the present invention is the statistical information that can be generated in a graphical form. Statistics are available for flow and for ports. Figure 10 is an example of a port-based statistics page. Figure 11 is an example of a port-based statistics graph.

Figure 12 is an example of a protocol statistics page. The administrator can choose to view statistics in real time, over the last 24 hours, the last week, the last month, and the last year. Figure 13 is an example of a protocol statistics graph.

Application modules for a selected configuration are displayed in the COREVISTA WEB(TM) tool pane 202, and are grouped by module type. Figure 14 is an example of an APACHE(TM) management page. Figure 15 is an example of a Virtual Hosts Page.

The present invention also enables configuration of bandwidth settings. Bandwidth management enables the administrator to specify the amount of IP traffic

down to a port-by-port level. Bandwidth management operates by dividing packets into flows according to a specified mask on IP header fields. Packets belonging to a specific flow are then passed to either a pipe,  
5 which emulates a link with specific transmission parameters, or to a queue, which associates a weight and a reference pipe to a flow, which is then scheduled at the rate fixed by the pipe. Figure 16 is an example of a Bandwidth Management page.

10 The present invention also enables the administrator to configure DHCP settings. Under DHCP, a computer is designated as the DHCP server. All of the other computers you specify on the network are DHCP clients. Figure 17 is an example of a DHCP  
15 network parameters page.

The present invention also enables the administrator to configure DNS settings. DNS is a distributed database that keeps track of the different host names, network names, and IP addresses used on  
20 the Internet. DNS is responsible for translating alphanumeric domain names into actual IP addresses. It provides the mapping between IP addresses and hostnames. DNS configuration takes place in four areas: resolv.conf entries, DNS forwarders, zone  
25 information, and zones. Figure 18 is an example of a DNS management page.

Whereas routing enables the administrator to specify how to route packets, a firewall enables the administrator to decide, with specific detail, whether  
30 to route packets. COREVISTA WEB(TM) enables the administrator to easily create, view, modify or update the firewall rules in the Firewall module. The Open IP Services Platform is preconfigured with a default

firewall rule that allows all network traffic from the outside to enter the LAN, and vice versa. It all comes with another firewall rule that denies all network traffic from the outside to the LAN, and vice versa. Figure 19 is an example of a Firewall Management page.

Figure 20 is an example of a Network Address Translation (NAT) Interface page. Before creating or modifying NAT rules, the administrator must determine if the Open IP Services Platform will implement dynamic NAT or static NAT. Static NAT is a lot like port forwarding, described below, except that Static NAT is implemented in a per-IP address basis, rather than on a per-port basis. A static NAT rule would in effect say: "All traffic to public IP Address X will be forwarded to private IP address Y." Under static NAT, the administrator assigns private IP addresses, under dynamic NAT, they are assigned on a first-come, first-served basis. In order to use the Open IP Services Platform NAT module, the administrator must have at least one rule specified in the Firewall module that specifies some type of "allow" action. Otherwise, no traffic will ever reach the NAT module.

Figure 21 is an example of the Network Management Page. The Network Management module enables the administrator to configure network settings including global network settings, interface settings, network date and time settings, and halting or rebooting of the Open IP Services Platform. Figure 22 is an example of the Interface Management page.

Figure 23 is an example of the Port Forwarding page. Port forwarding enables the administrator to forward packets from the Internet to a computer on a

private network. The advantage to this is similar to the advantage to using NAT: the computer on the private network to which the packets are forwarded does not need a valid public IP address. COREVISTA WEB(TM) enables the administrator to specify port forwarding rule chains that govern how ports are forwarded, depending on who or where the network traffic is being sent from.

Figure 24 is an example of the qmail Management Page which enables the administrator to easily add domains for qmail, which is the Open IP Services Platform mail server.

Figure 25 is an example of the Routing Configuration page. IP is the session-layer protocol that provides secure communication for TCP/IP networks and the Internet. The routing module can be configured to regulate packet forwarding by tracking addresses, routing outgoing messages, and recognizing incoming messages.

Figure 26 is an example of the SANGOMA(TM) Interface page. This page enables the administrator to set the data rate, protocol, clocking, etc.

Figure 27 is an example of the VLAN Management page. The Open IP Services Platform enables the creation of up to 26 different port-based VLANs. With COREVISTA WEB(TM), it is possible to establish and manage VLANs.

Figure 28 is an example of the VPN Client Configuration page. A VPN is a private connection between two machines or networks over a shared or public network. Virtual private networks operate by encapsulating regular IP traffic inside an encrypted IP channel. Because the Internet has emerged as both

the largest and the least expensive WAN in the world, many companies are forming VPNs as private WANs. COREVISTA WEB(TM) can configure VPN client and VPN server services, as well as specify the VPN user name and password.

5

Figure 29 is an example of the FTP page. Figure 30 is an example of the SSH page. Figure 31 is an example of the SWAT page, which provides access to SAMBA(TM)'s SWAT configuration tool without opening a second browser window. Figure 32 is an example of the WEBMIN(TM) page.

10

Having shown the various features of COREVISTA WEB(TM), it is now easy to show the additional services offered by COREVISTA(TM). COREVISTA(TM) enables the administrator to perform all of the functions of COREVISTA WEB(TM), and also provides the further advantageous feature of drag-and-drop configuration of a network.

15

Figure 33 is an example of a COREVISTA(TM) configuration page. In this page, the left hand side contains an objects pane 220. The objects pane includes icons that represents network functions that are offered by the particular Open IP Services Platform being configured. These icons are ActiveX objects that represent the network functions. The right hand side is the configuration pane 222. Configuring a network is as simple as selecting an object from the objects pane 220 and dragging it to the configuration pane 222. As network functions are dragged and dropped into the configuration pane 222, the interconnections between these functions is also made. For example, a line is drawn between a FireWall icon 224 and a PacketShaper 226. Thus, the

20

25

30

administrator creates the structure of the network in the graphical interface. Advantageously, the administrator is also able to specify specific ports if desired, or allow COREVISTA(TM) to make the desired connections as it sees fit. It should be remembered that only those network functions within the Open IP Services Platform are those portions of the network that are being created. Network functions and devices outside the Open IP Services Platform are not shown. COREVISTA(TM) makes the appropriate interconnections within the hardware of the Open IP Services Platform. Thus, the present invention takes advantage of the versatility of the Open IP Services Platform by making the ability of the platform to

It is to be understood that the above-described arrangements are only illustrative of the application of the principles of the present invention. Numerous modifications and alternative arrangements may be devised by those skilled in the art without departing from the spirit and scope of the present invention. The appended claims are intended to cover such modifications and arrangements.

Claims

What is claimed is:

1. A method for configuring the functions of an Open IP Services Platform, said method comprising the steps of:
  - 1) providing an Open IP Services Platform which integrates the functions of at least two network devices in a single unit;
  - 2) providing configuration and management software in the Open IP Services Platform that enables the functions of the at least two network devices to be configured and managed; and
  - 3) configuring interconnections between the at least two network devices in accordance with settings programmed using the configuration and management software.
2. A system including configuration and management software for controlling an Open Internet Protocol (IP) services platform that integrates the functions of at least two network services in a single unit that does not require external wires to couple the at least two network services together, said system comprising:
  - a single board computer (SBC), including memory;
  - an open architecture Operating System (OS) stored in the memory;
  - at least two bus connectors for receiving cards that perform network functions, wherein the at least two bus connectors are coupled to the SBC;
  - a switch/router board coupled to the single board computer;
  - a plurality of network ports, wherein the



plurality of network ports are coupled on a first side to the switch/router board, and provide a connection to a network on a second side thereof; and

configuration and management software for  
5 controlling interconnections between the at least two bus connectors, the switch/router board, and the SBC.

3. The system as defined in claim 2 wherein the open  
architecture Operating System is selected from the  
10 group of Operating Systems comprised of FreeBSD and Linux.

4. The system as defined in claim 3 wherein the at  
least two bus connectors further comprise peripheral  
15 component interconnect (PCI) bus connectors.

5. The system as defined in claim 4 wherein the  
switch/router board is further comprised of:  
a PCI to PCI bus bridge;  
20 a PCI to PCMCIA bus bridge;  
at least one random access memory module; and  
a media switch for performing switch and router  
function.

25 6. The system as defined in claim 5 wherein the plurality of network ports further comprises:  
at least two gigabit ethernet ports;  
at least twelve 10/100 ethernet ports; and  
at least two PCMCIA type 2 expansion ports.

30

7. The system as defined in claim 6 wherein the plurality of network ports further comprises at least one universal serial bus (USB) port.

8. The system as defined in claim 7 wherein the at least two PCI bus connectors are coupled to network card performing network functions, wherein the network functions are selected from the group of network functions comprising routers, switches, load balancers, bridges, firewalls, packet shapers, and servers.

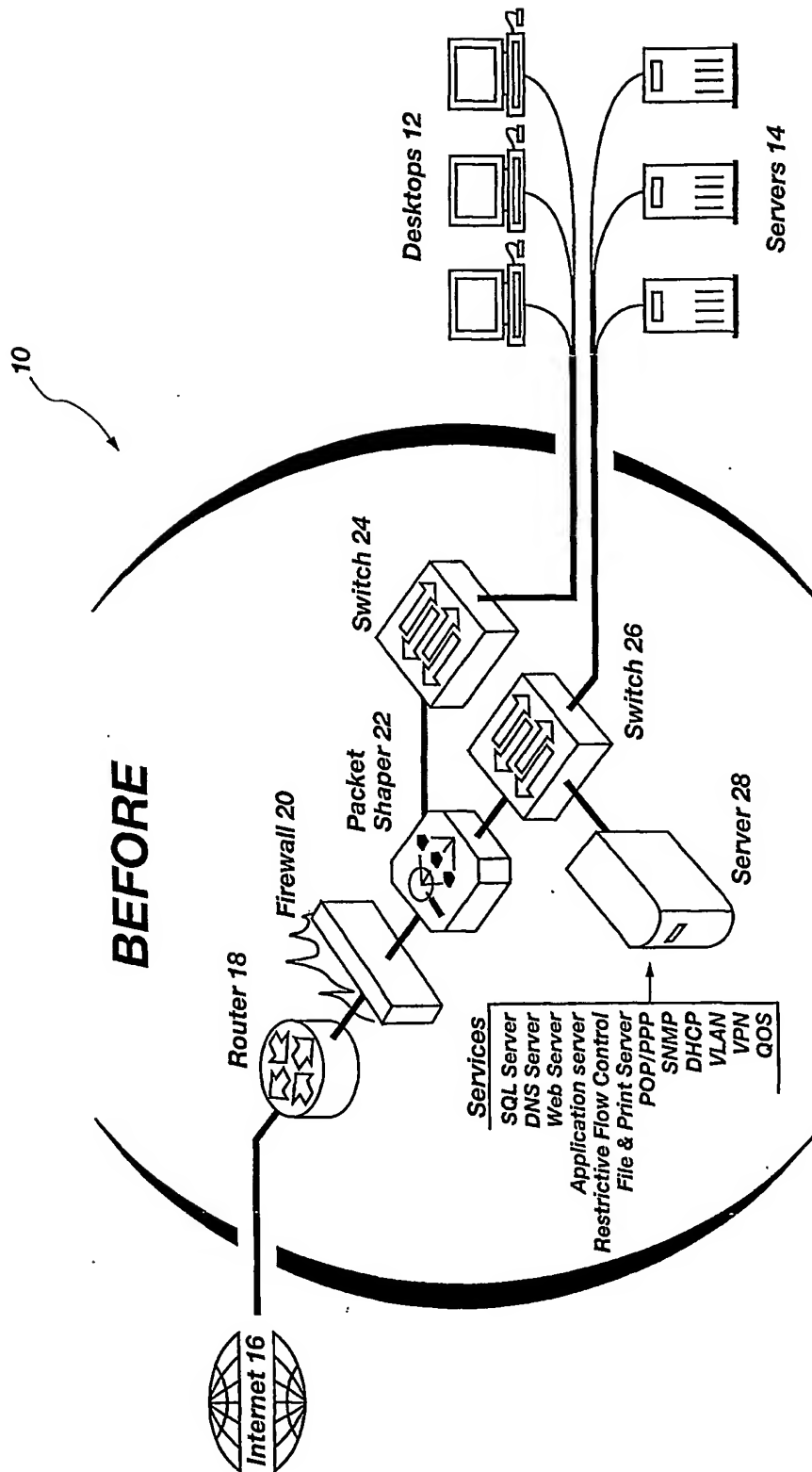
9. The system as defined in claim 8 wherein the SBC further comprises a microprocessor that is selected from the group of microprocessors comprised of general purpose microprocessors and special purpose microprocessors.

10. The system as defined in claim 9 wherein the configuration software further comprises a software utility that enables drag-and-drop configuration of network components, to thereby simplify configuration of network components within the Open IP Services Platform.

11. The system as defined in claim 10 wherein the configuration software utilizes icons that are representative of the network components, wherein the icons are ActiveX modules that define the functions that are performed by the network components.

12. The system as defined in claim 11 wherein the switch/router board is a level 4 network device that is capable of communicating with other Open IP Services Platforms at wire speed.

13. The system as defined in claim 12 wherein the system further comprises a solid state refrigeration unit, where the refrigeration unit is disposed directly on a case of a hard drive, thereby directing cooling efforts directly on the most temperature sensitive device within the Open IP Services Platform.



**Fig. 1**  
(PRIOR ART)

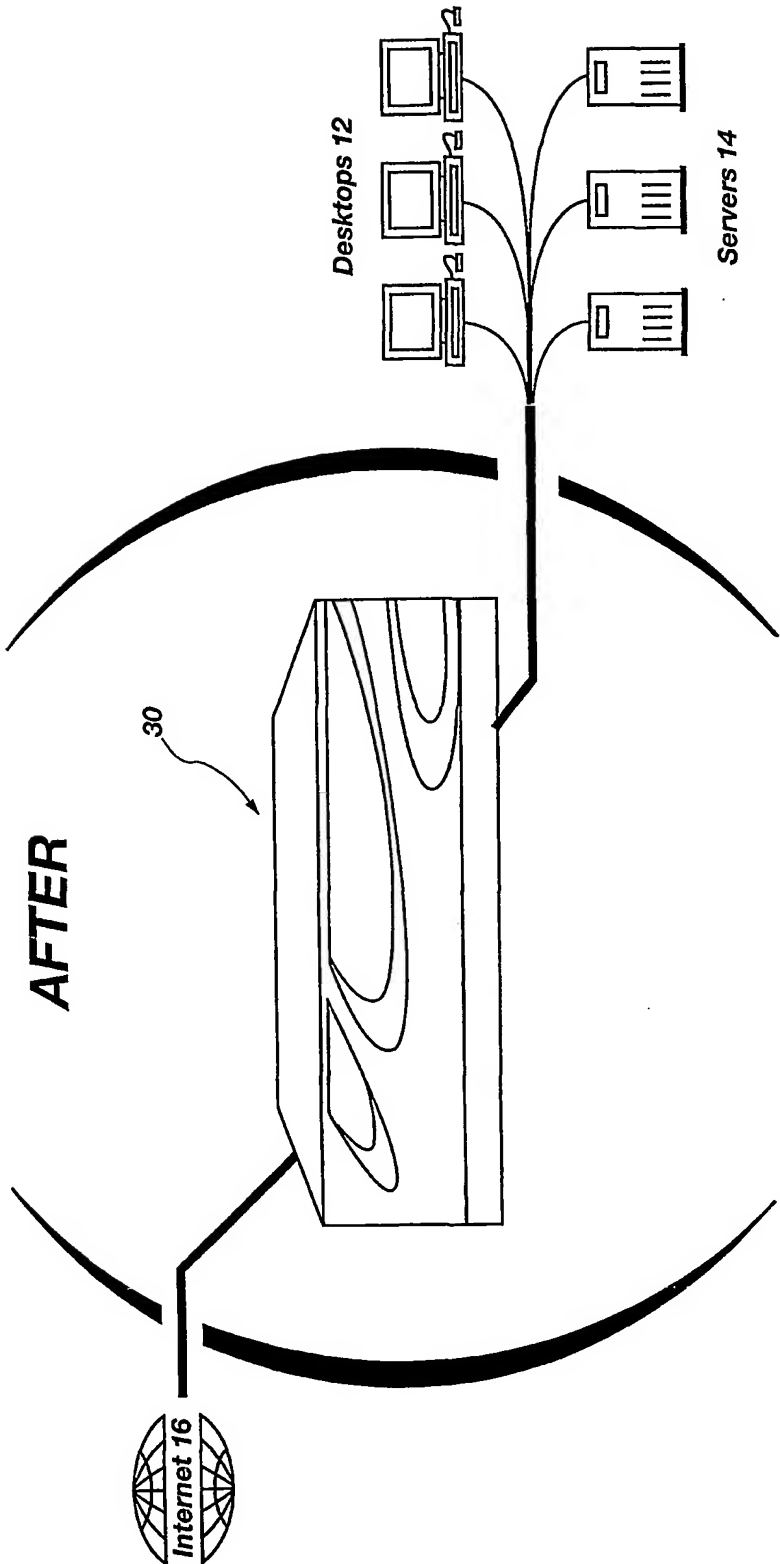


Fig. 2

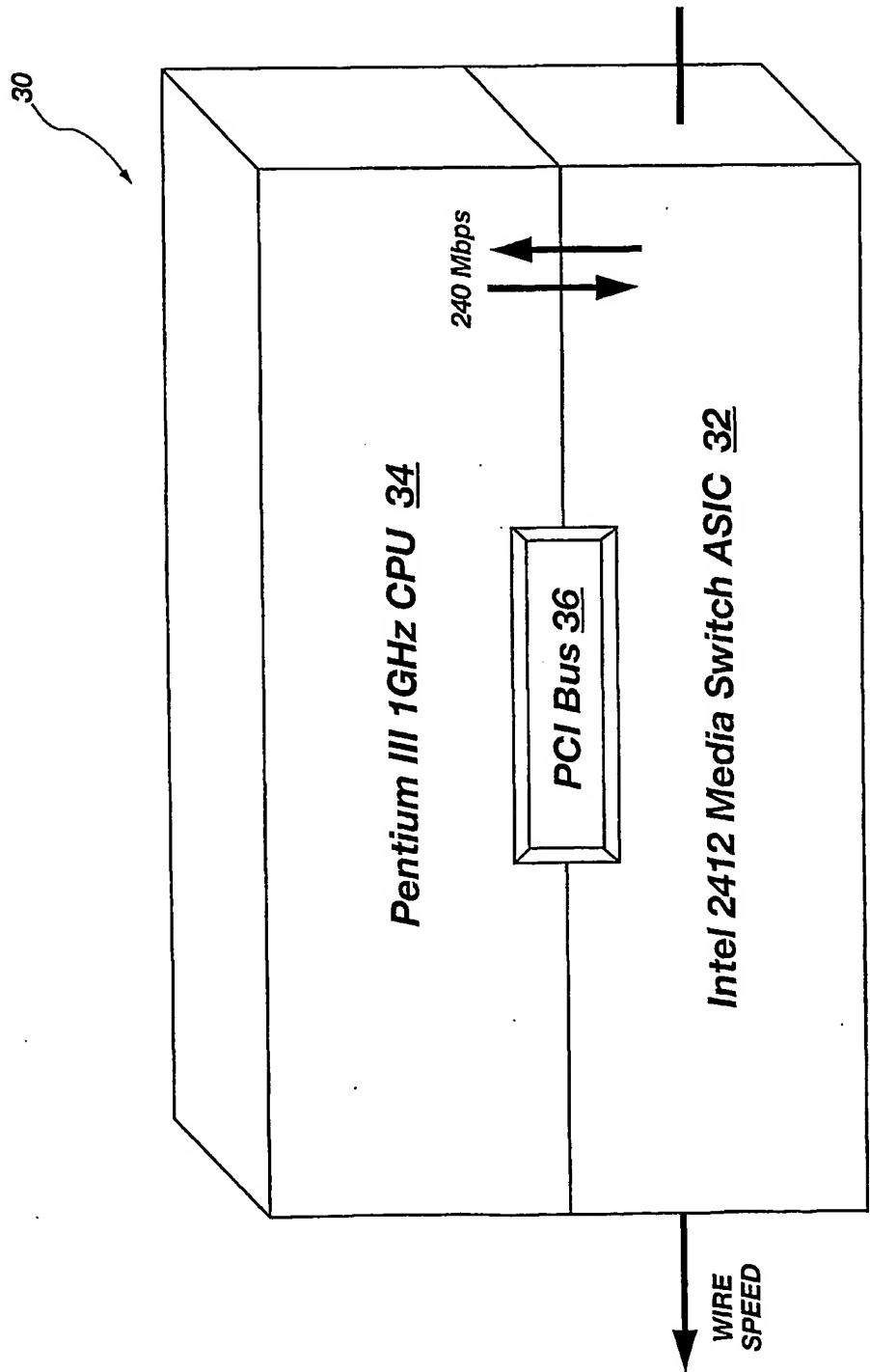


Fig. 3

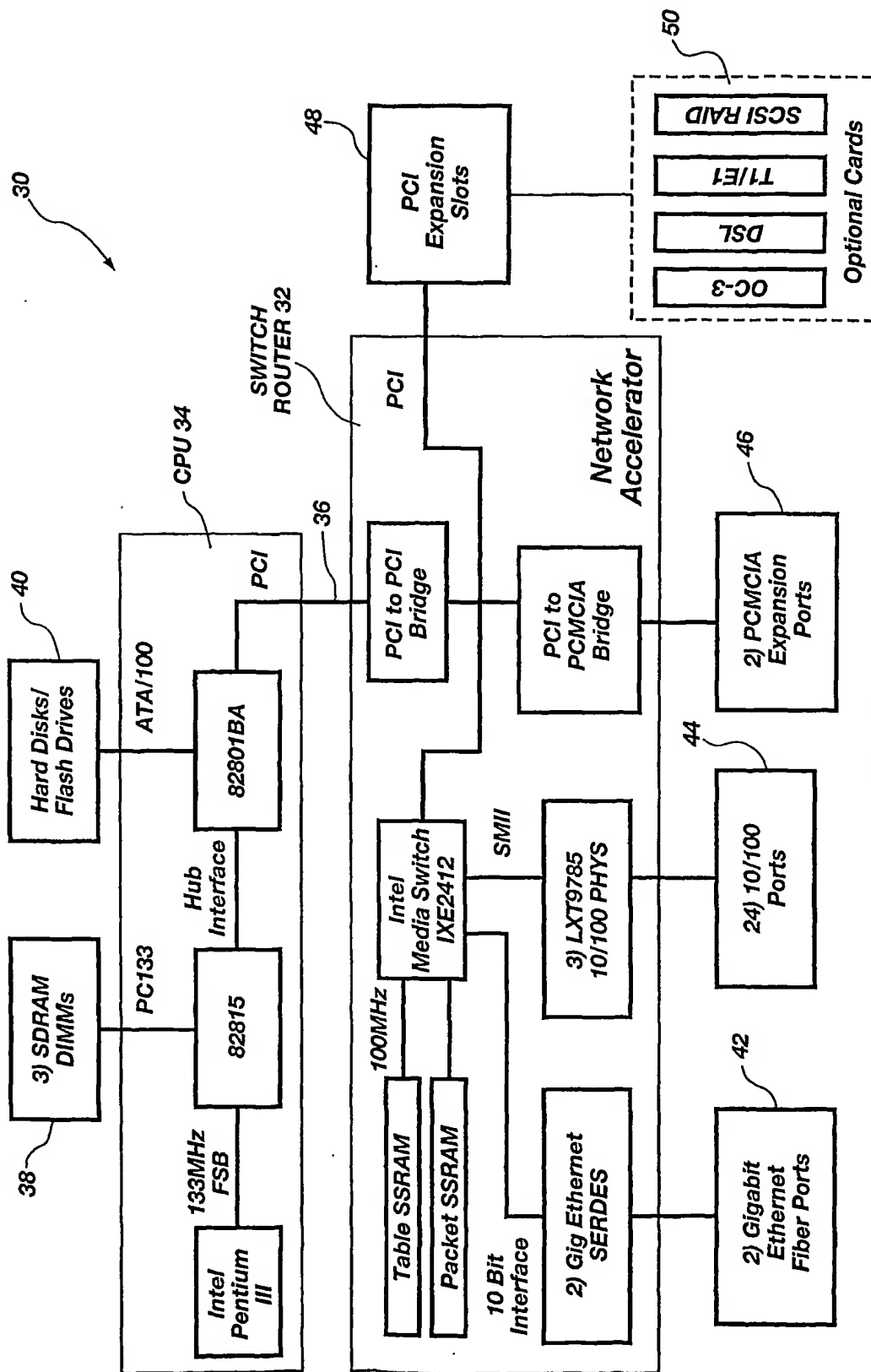


Fig. 4

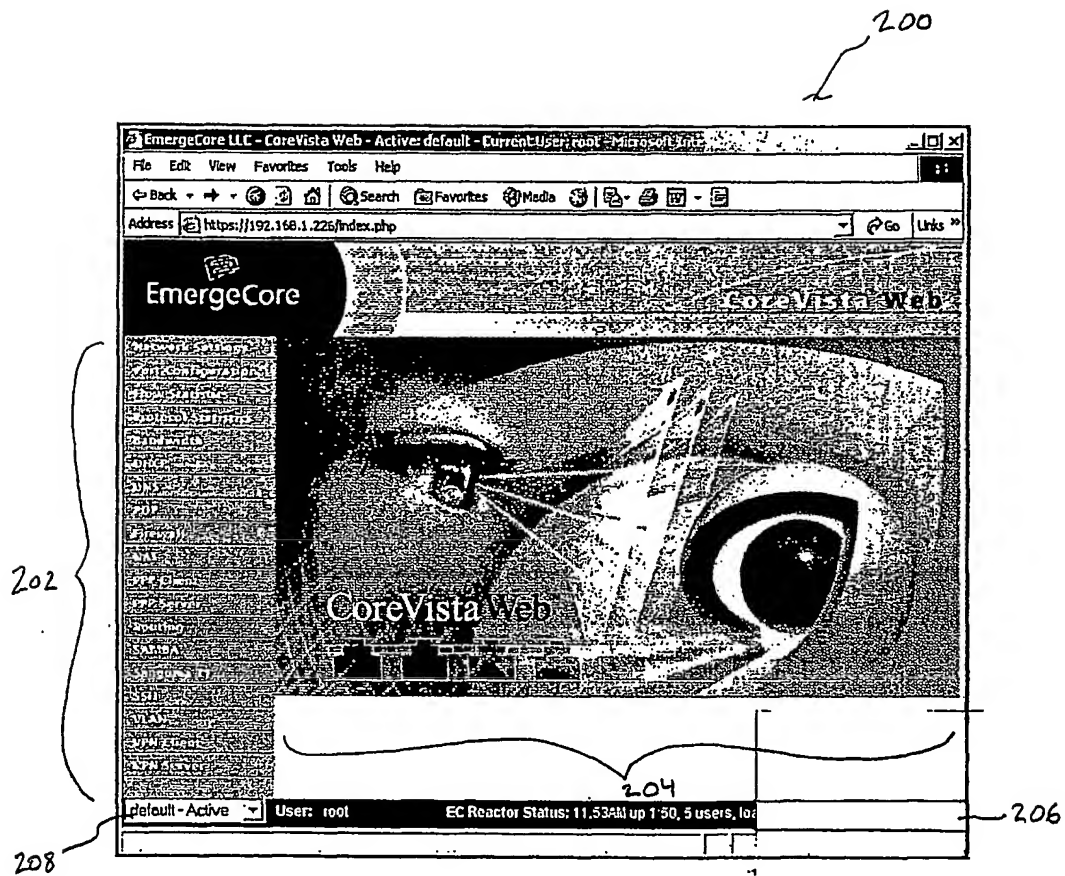


FIGURE 5



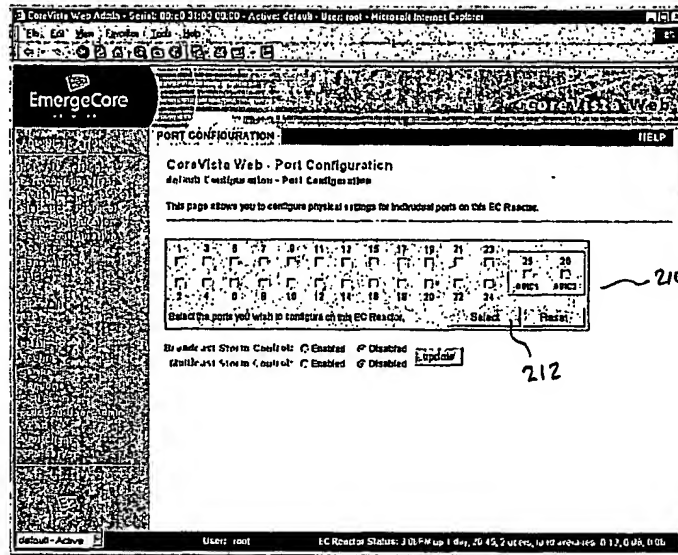


FIGURE 6

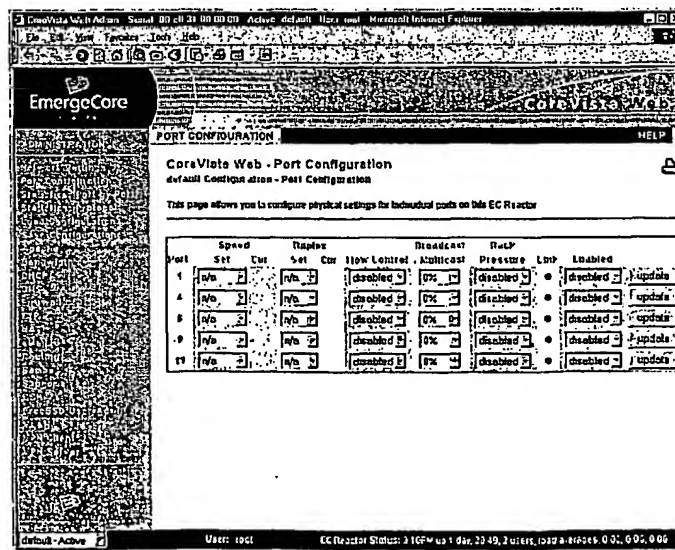


FIGURE 7

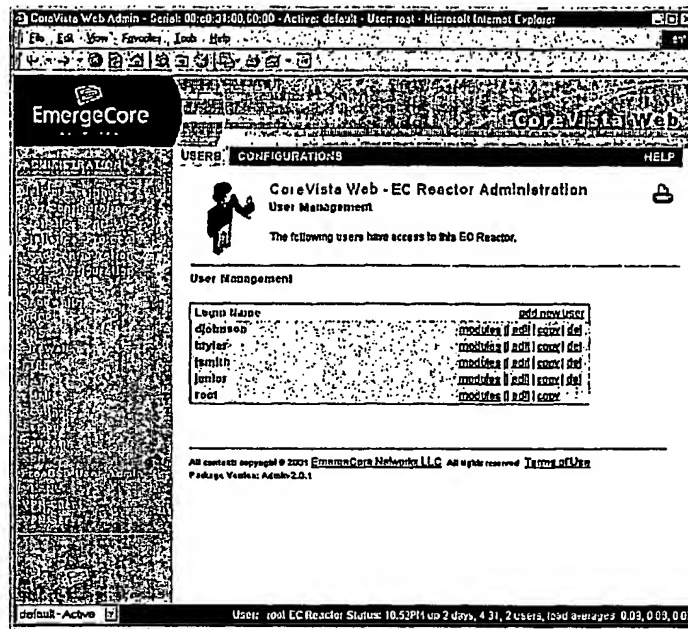


FIGURE 8

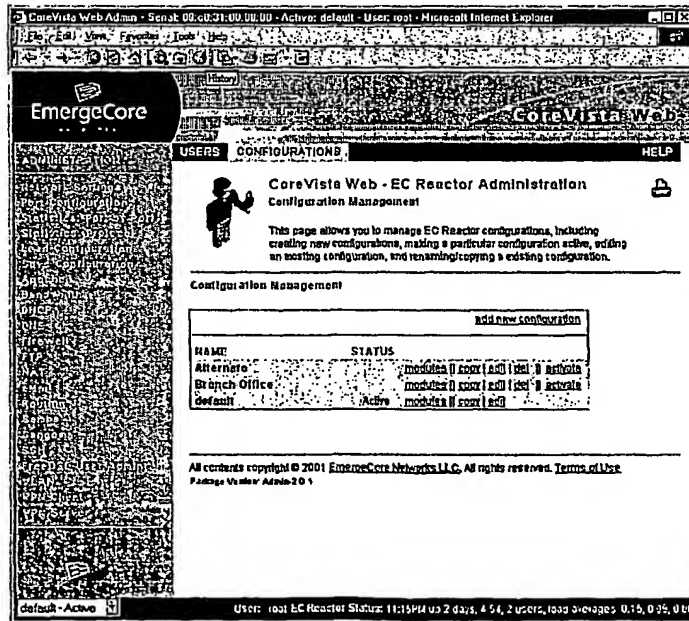


FIGURE 9

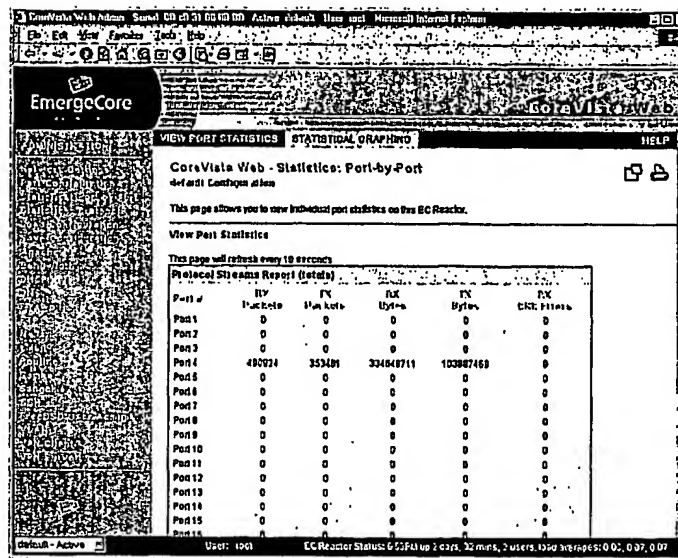


FIGURE 10

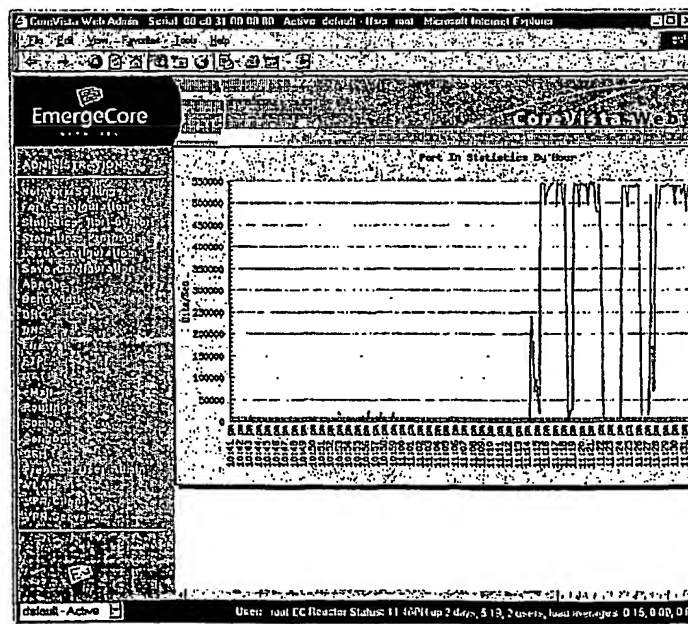


FIGURE 11

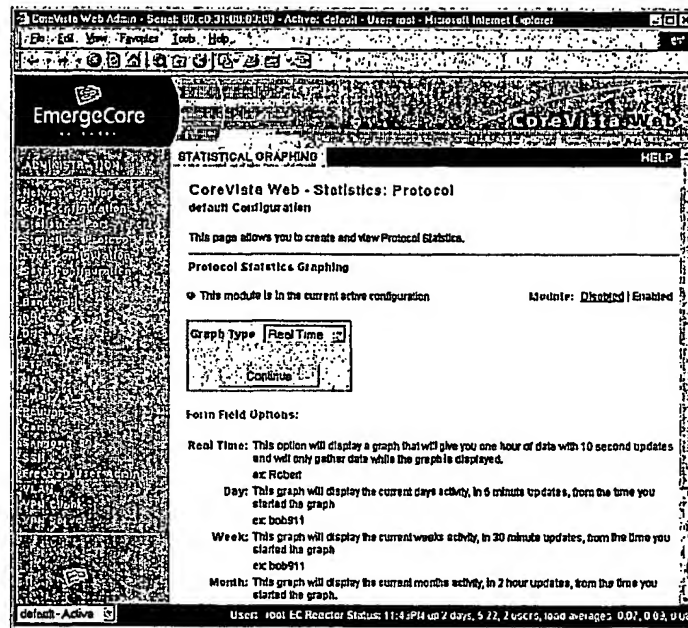


FIGURE 12

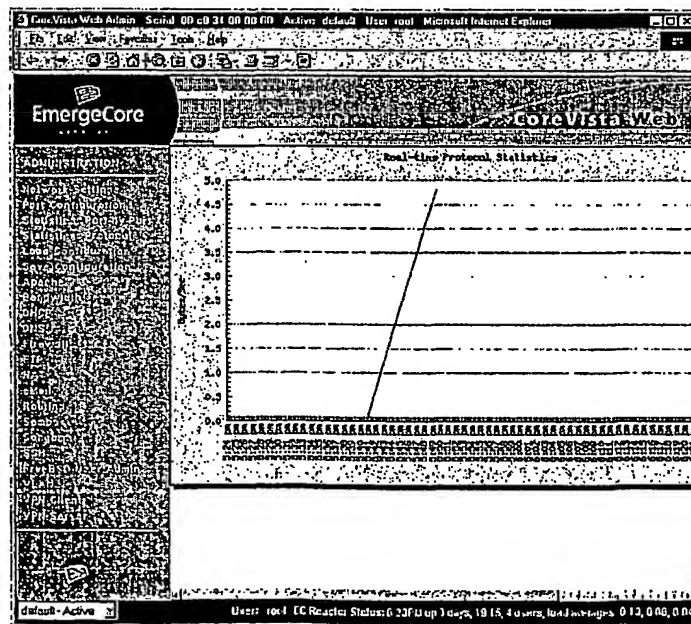


FIGURE 13

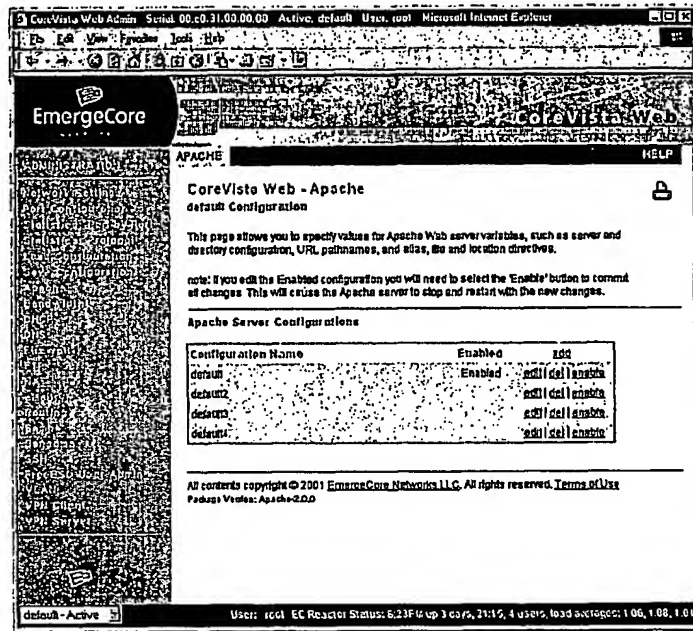


FIGURE 14

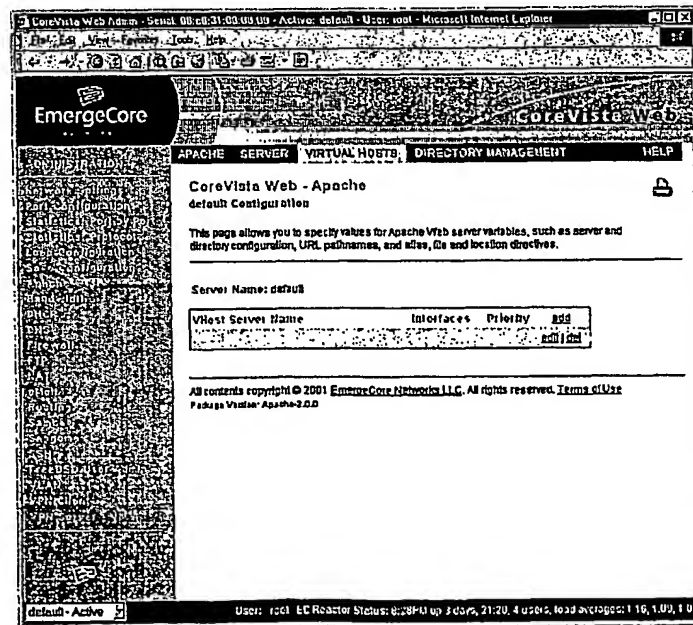


FIGURE 15

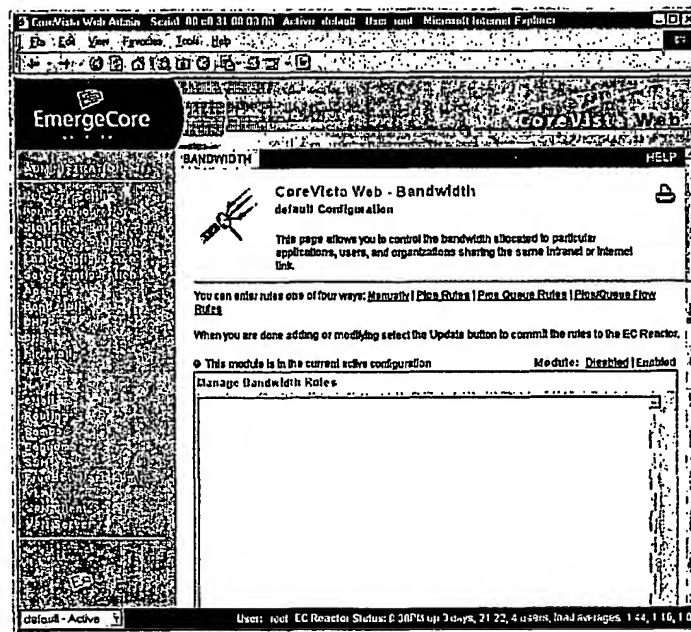


FIGURE 16

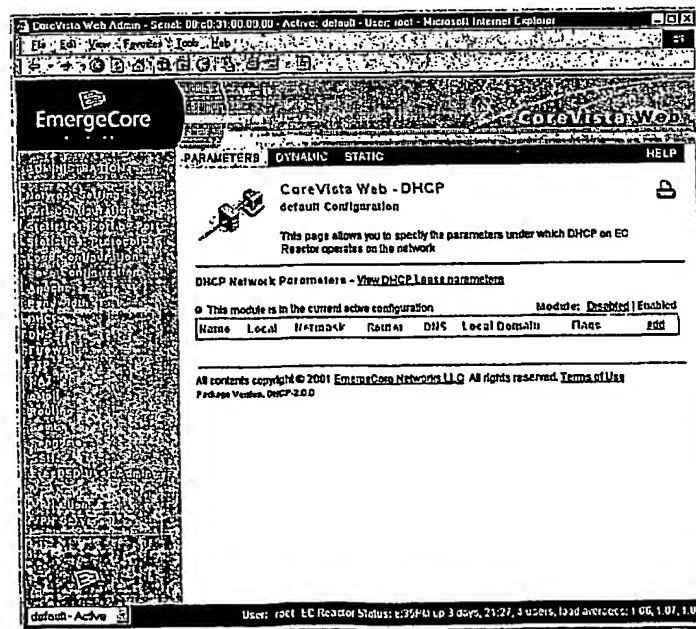


FIGURE 17

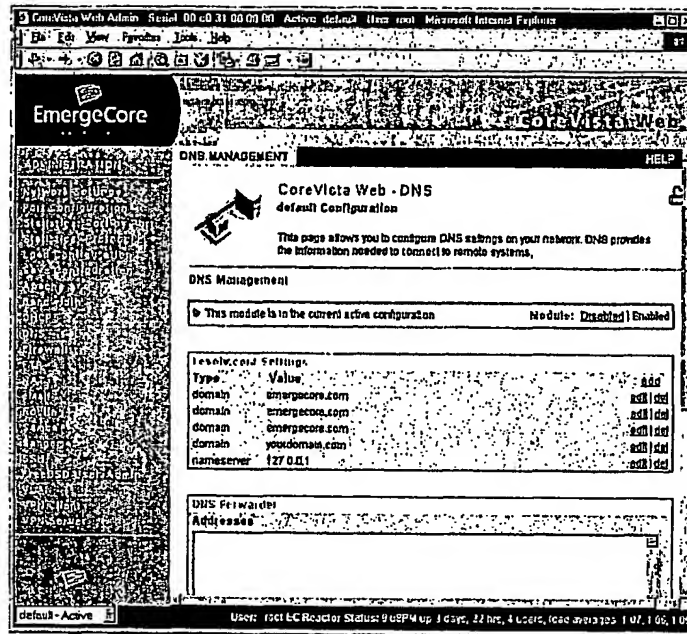


FIGURE 18

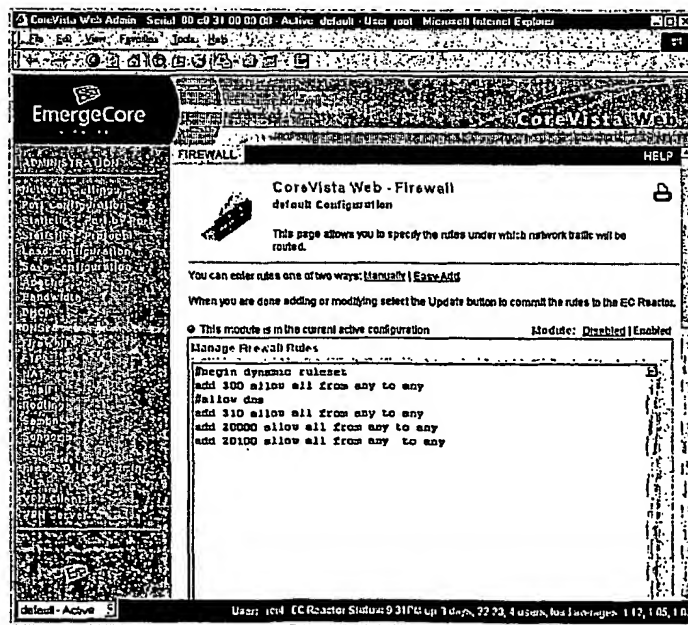


FIGURE 19

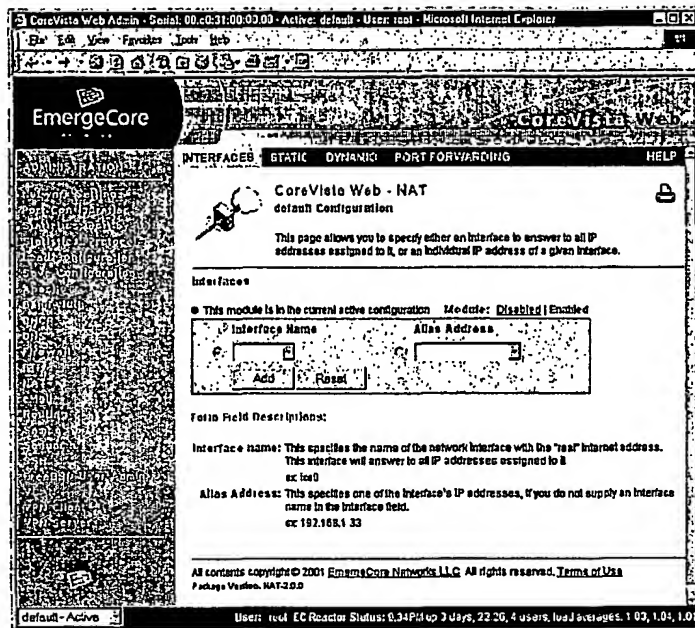


FIGURE 20

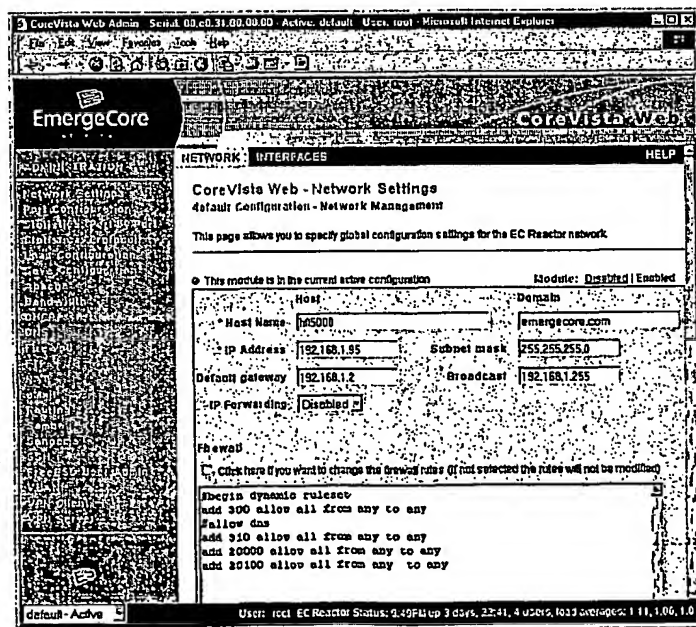


FIGURE 21



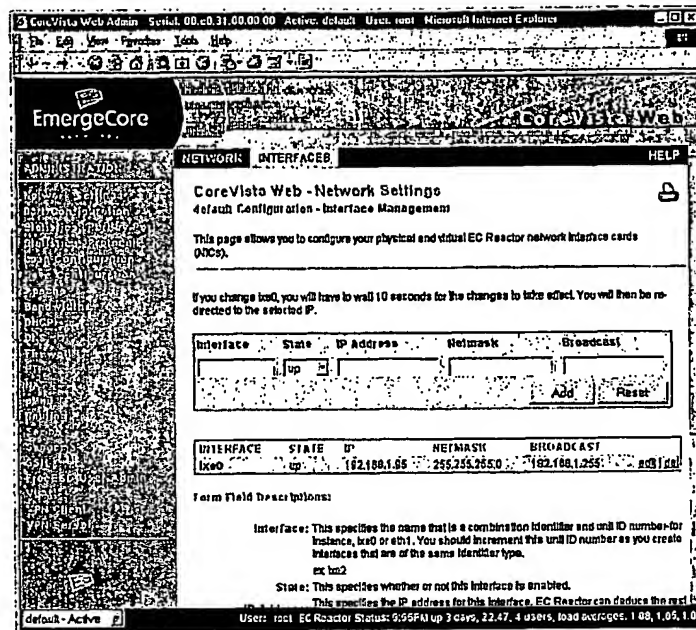


FIGURE 22

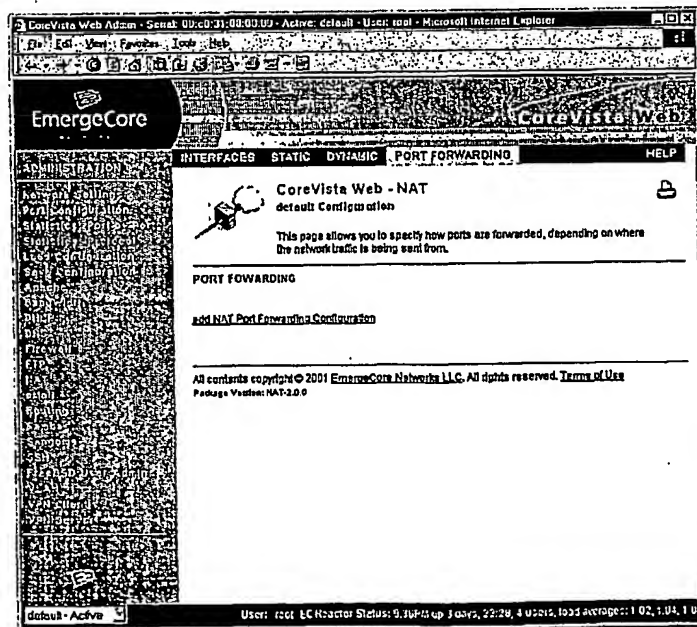


FIGURE 23

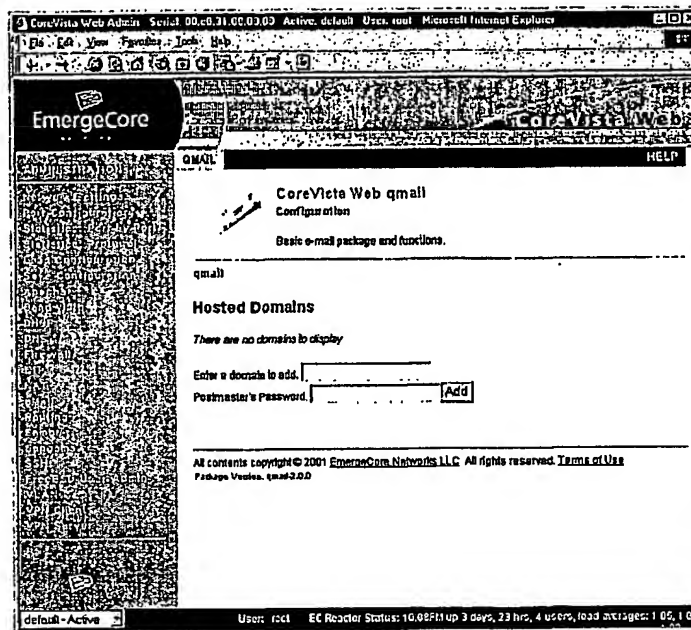


FIGURE 24

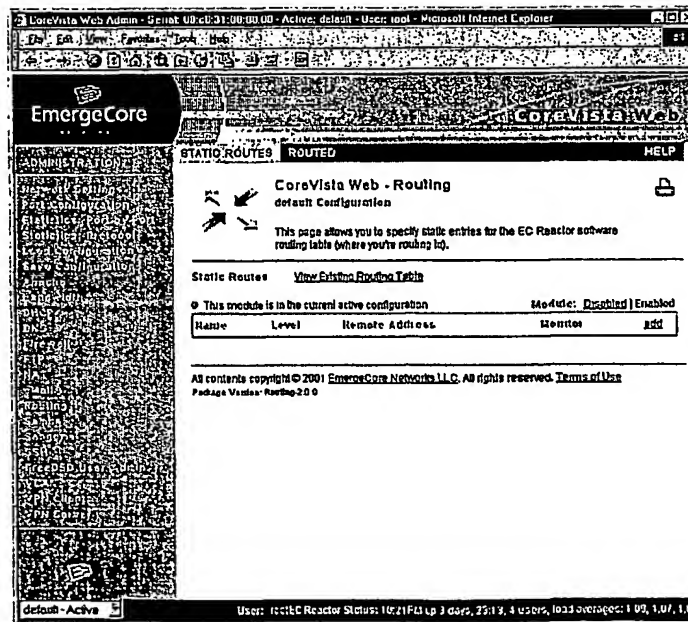


FIGURE 25

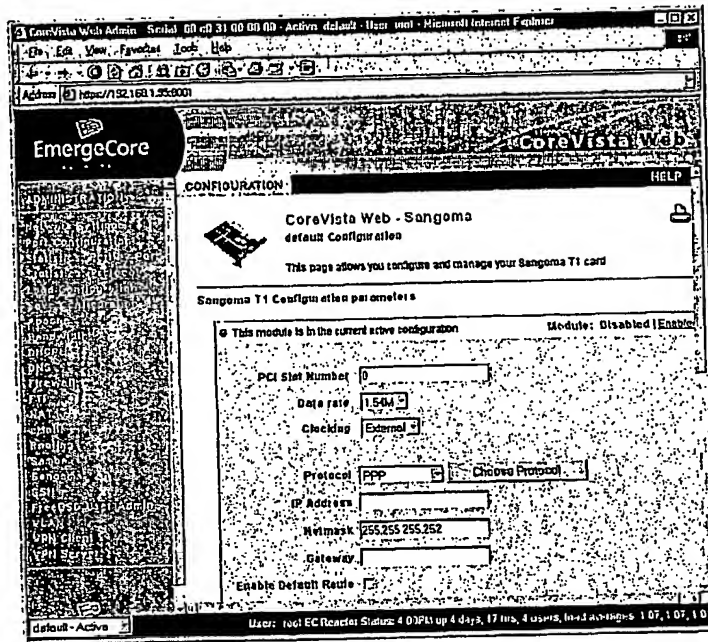


FIGURE 26

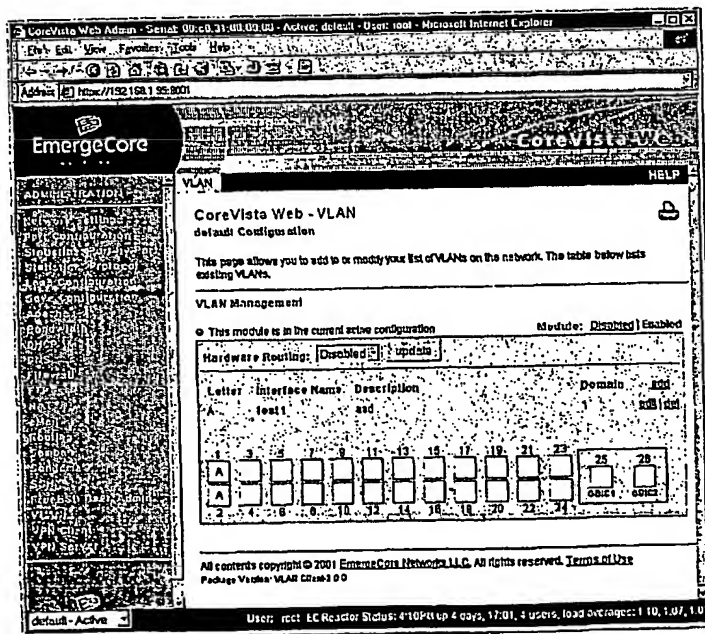


FIGURE 27

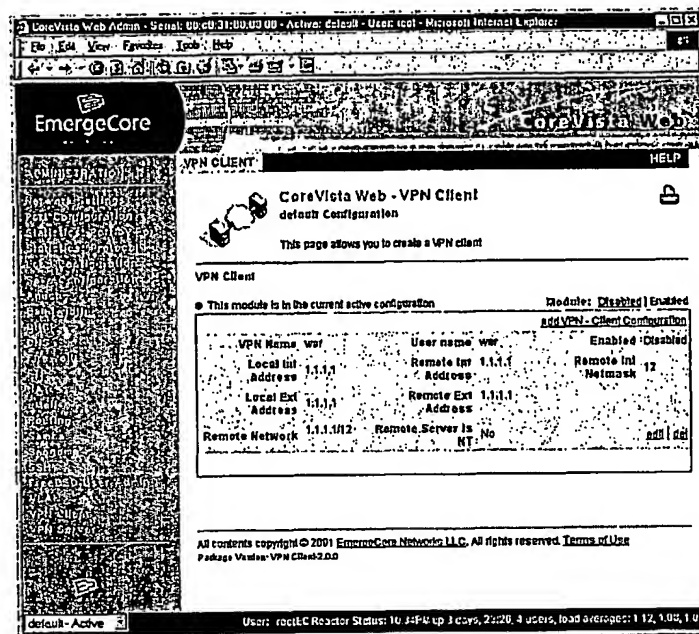


FIGURE 28

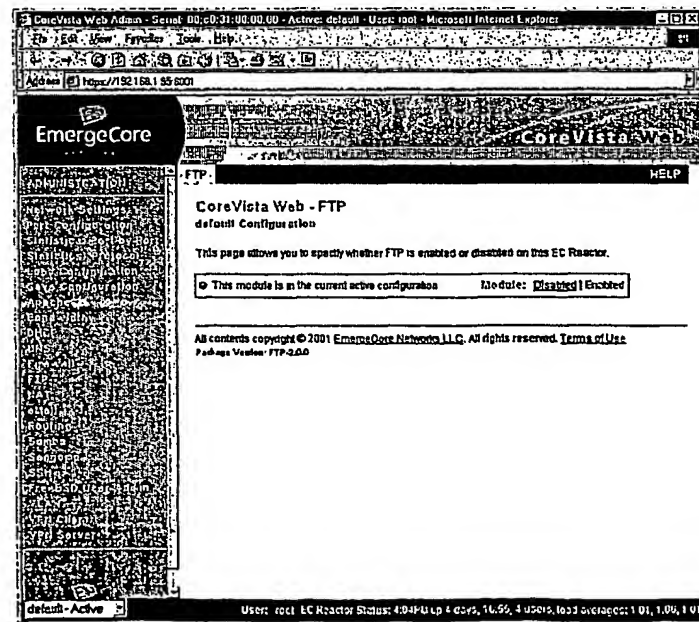


FIGURE 29

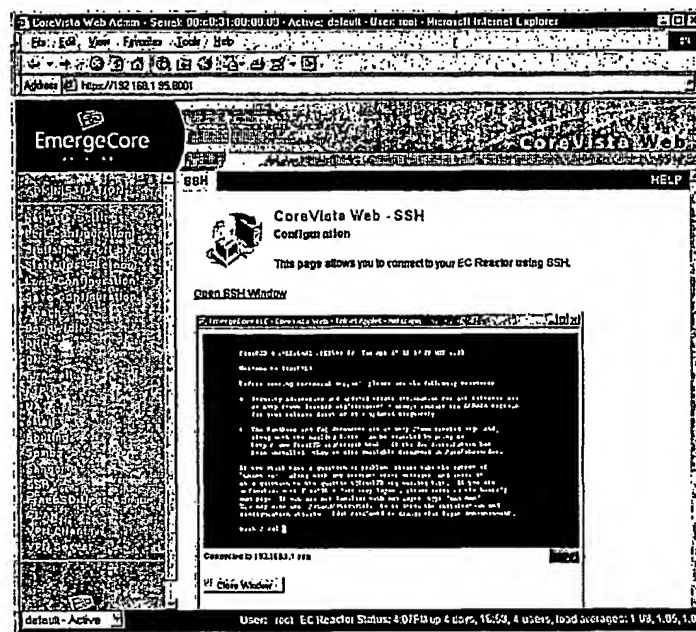


FIGURE 30

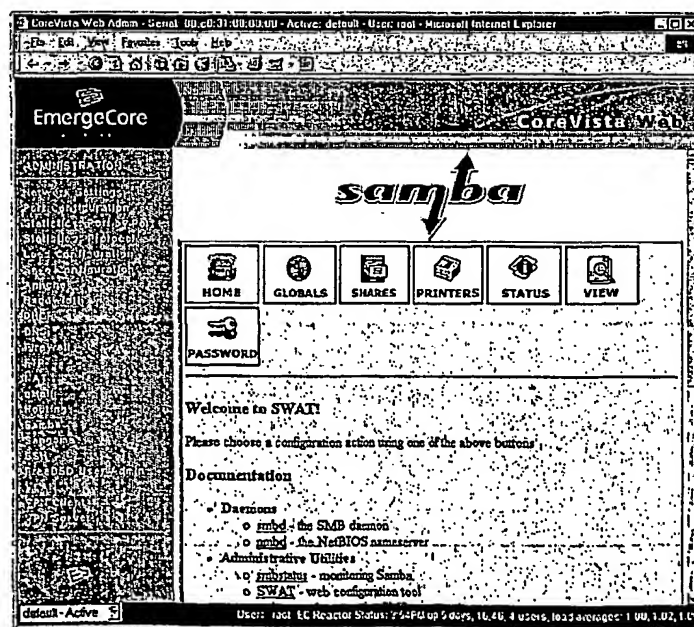


FIGURE 31

CoreVista Web Admin - Serial: 0040314000000000 - Active: default - User: root - Microsoft Internet Explorer

CoreVista Web Admin

Home Module Config

Users and Groups

Local Users

Username	User ID	Real Name	Home directory	Shell
root	0	Charlie &	/root	/bin/csh
root	0	Bounce-again Superuser	/root	
daemon		Owner of many system processes	/root	/sbin/nologin
operator	2	System &		/sbin/nologin
bin		Executes Commands and Scripts		/sbin/nologin
www	4	My Sandbox		/sbin/nologin
nmap	5	EMem Sandbox		/sbin/nologin
man	8	News Subsystem		/sbin/nologin
man	9	Master Man Pages	/usr/share/man	/sbin/nologin
ftp	153	Blind Sandbox		/sbin/nologin
ftp	166	UUCP pseudo-user	/usr/spool/uucppublic	/usr/libexec/uucp/lsn

User: root, EC Reader Status: 4.1274up 4 days, 17:03, 4 users, load average: 1.05, 1.05, 1.01

FIGURE 32

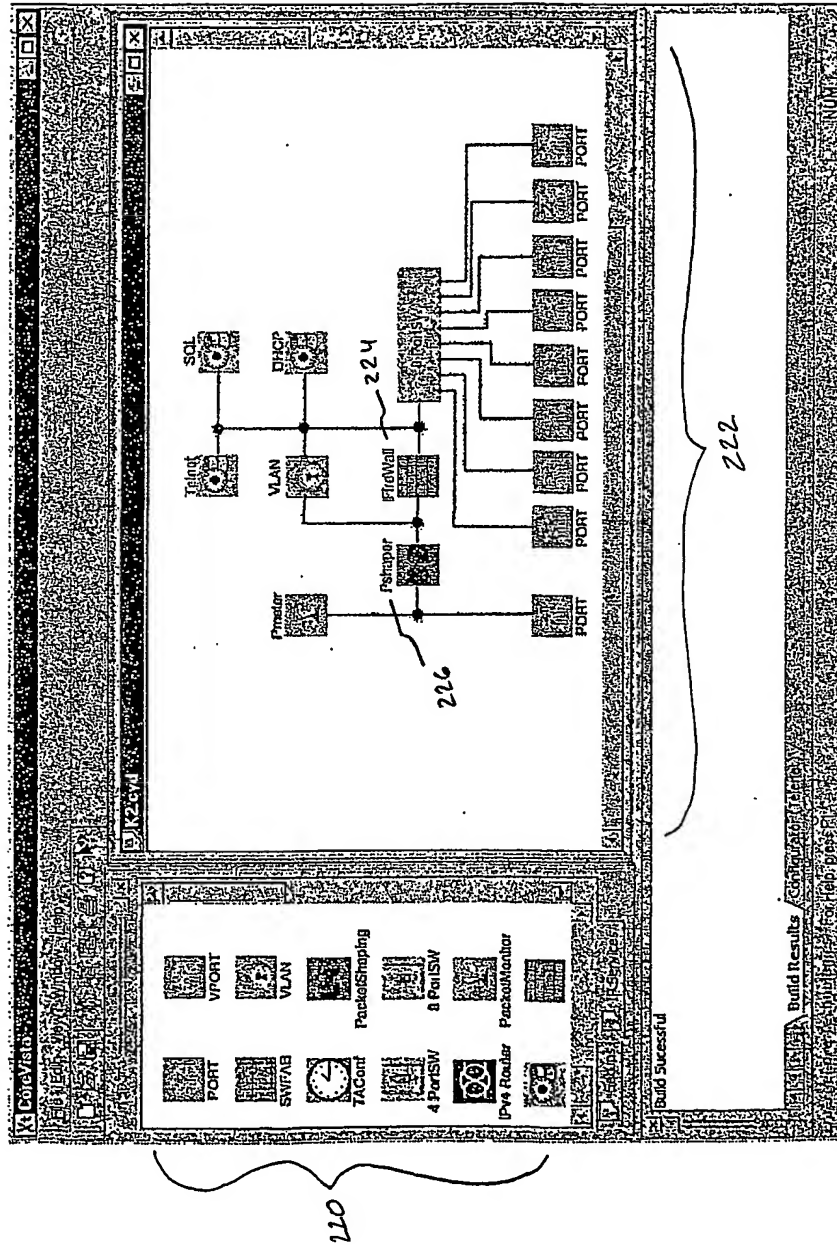


FIGURE 33

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US02/06000

<b>A. CLASSIFICATION OF SUBJECT MATTER</b>																										
IPC(7) : G06F 15/177, 15/178																										
US CL : 709/220, 221, 223, 224																										
According to International Patent Classification (IPC) or to both national classification and IPC																										
<b>B. FIELDS SEARCHED</b>																										
Minimum documentation searched (classification system followed by classification symbols)																										
U.S. : 709/220, 221, 223, 224																										
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched																										
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)																										
Please See Extra Sheet.																										
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>																										
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.																								
A	US 6,185,612 B1 (JENSEN et al) 06 FEBRUARY 2001, ABSTRACT, FIGURES 1 AND 2, COL. 8, LINES 29-67,.	1-13																								
Y	US 6,122,664 A (BOUKOBZA et al) 19 SEPTEMBER 2000, ABSTRACT, COL. 2, LINES 13-67, COL. 3, LINES 1-39,	1-13																								
Y	US 6,112,015 A (PLANAS et al) 29 AUGUST 2000, ABSTRACT, COL. 2, LINES 20-67, COL. 4, LINES 21-67, COL. 15, LINES 1-67	1-13																								
Y	US 6,076,106 A (HAMNER et al) 13 JUNE 2000, ABSTRACT, FIGURES 2A, 2B, COL. 3, LINES 5-46, COL. 4, LINES 10-65, COL. 5, LINES 34-48	1-13																								
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.																										
<table border="0"> <tr> <td colspan="2">* Special categories of cited documents:</td> <td>*T</td> <td>later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</td> </tr> <tr> <td>*A</td> <td>document defining the general state of the art which is not considered to be of particular relevance</td> <td>*X</td> <td>document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</td> </tr> <tr> <td>*E</td> <td>earlier document published on or after the international filing date</td> <td>*Y</td> <td>document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</td> </tr> <tr> <td>*L</td> <td>document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</td> <td>*g</td> <td>document member of the same patent family</td> </tr> <tr> <td>*O</td> <td>document referring to an oral disclosure, use, exhibition or other means</td> <td></td> <td></td> </tr> <tr> <td>*P</td> <td>document published prior to the international filing date but later than the priority date claimed</td> <td></td> <td></td> </tr> </table>			* Special categories of cited documents:		*T	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention	*A	document defining the general state of the art which is not considered to be of particular relevance	*X	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone	*E	earlier document published on or after the international filing date	*Y	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art	*L	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	*g	document member of the same patent family	*O	document referring to an oral disclosure, use, exhibition or other means			*P	document published prior to the international filing date but later than the priority date claimed		
* Special categories of cited documents:		*T	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention																							
*A	document defining the general state of the art which is not considered to be of particular relevance	*X	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone																							
*E	earlier document published on or after the international filing date	*Y	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art																							
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*O	document referring to an oral disclosure, use, exhibition or other means																									
*P	document published prior to the international filing date but later than the priority date claimed																									
Date of the actual completion of the international search		Date of mailing of the international search report																								
03 JUNE 2002		27 JUN 2002																								
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231		Authorized officer <i>William C. Vaughn, Jr.</i> WILLIAM C. VAUGHN, JR.																								
Facsimile No. (703) 305-3230		Telephone No. (703) 305-4815																								



# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US02/06000

## B. FIELDS SEARCHED

Electronic data bases consulted (Name of data base and where practicable terms used):

EAST, INTERNET, NPL

search terms; configuration, network, topology, management software, open ip, network device, platform, connector, ports, gui, router, switch, switches, gateway, snmp, agents